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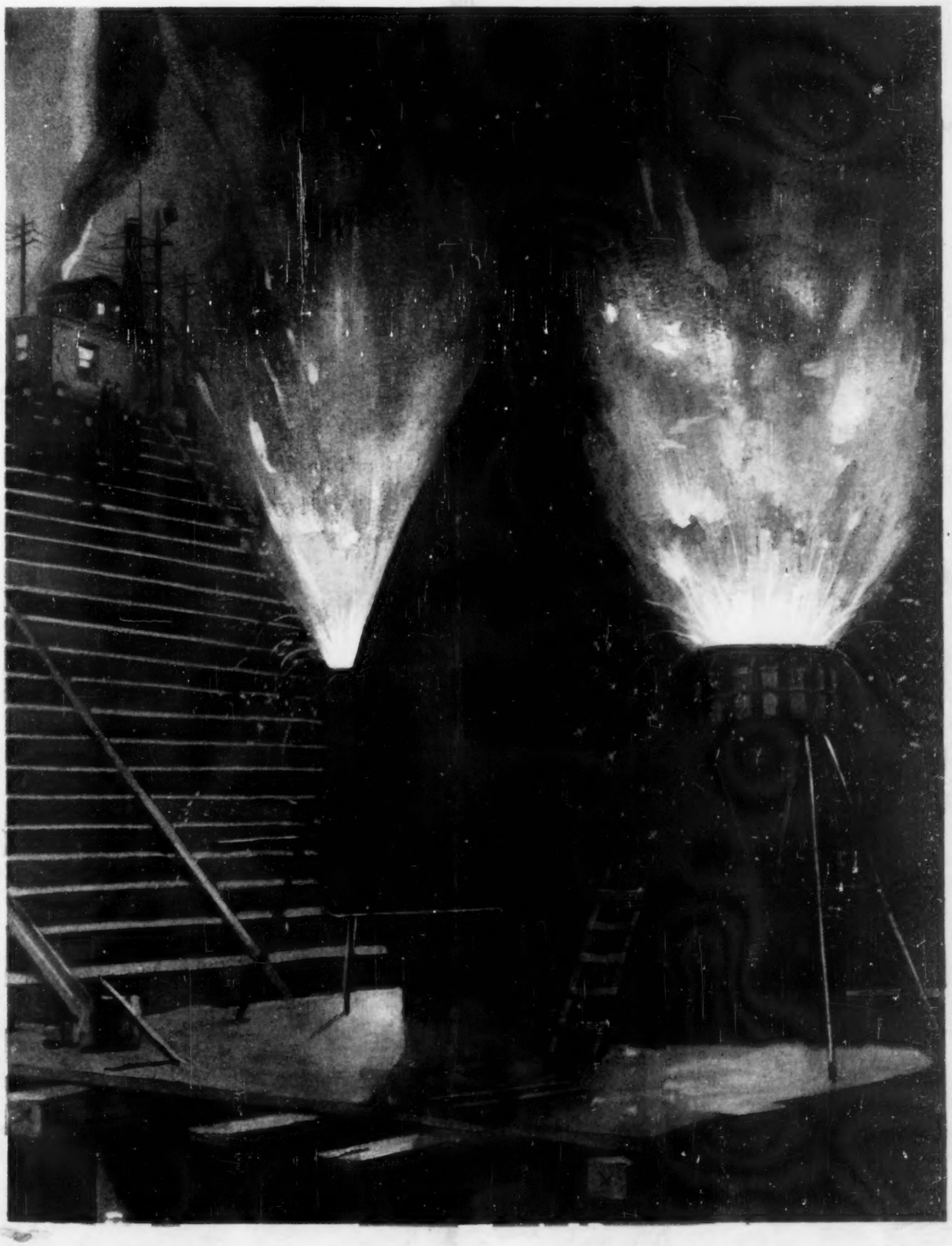

WELDING THE BROKEN STERN-FRAME OF THE "NORTHERN PACIFIC"—[See page 130]

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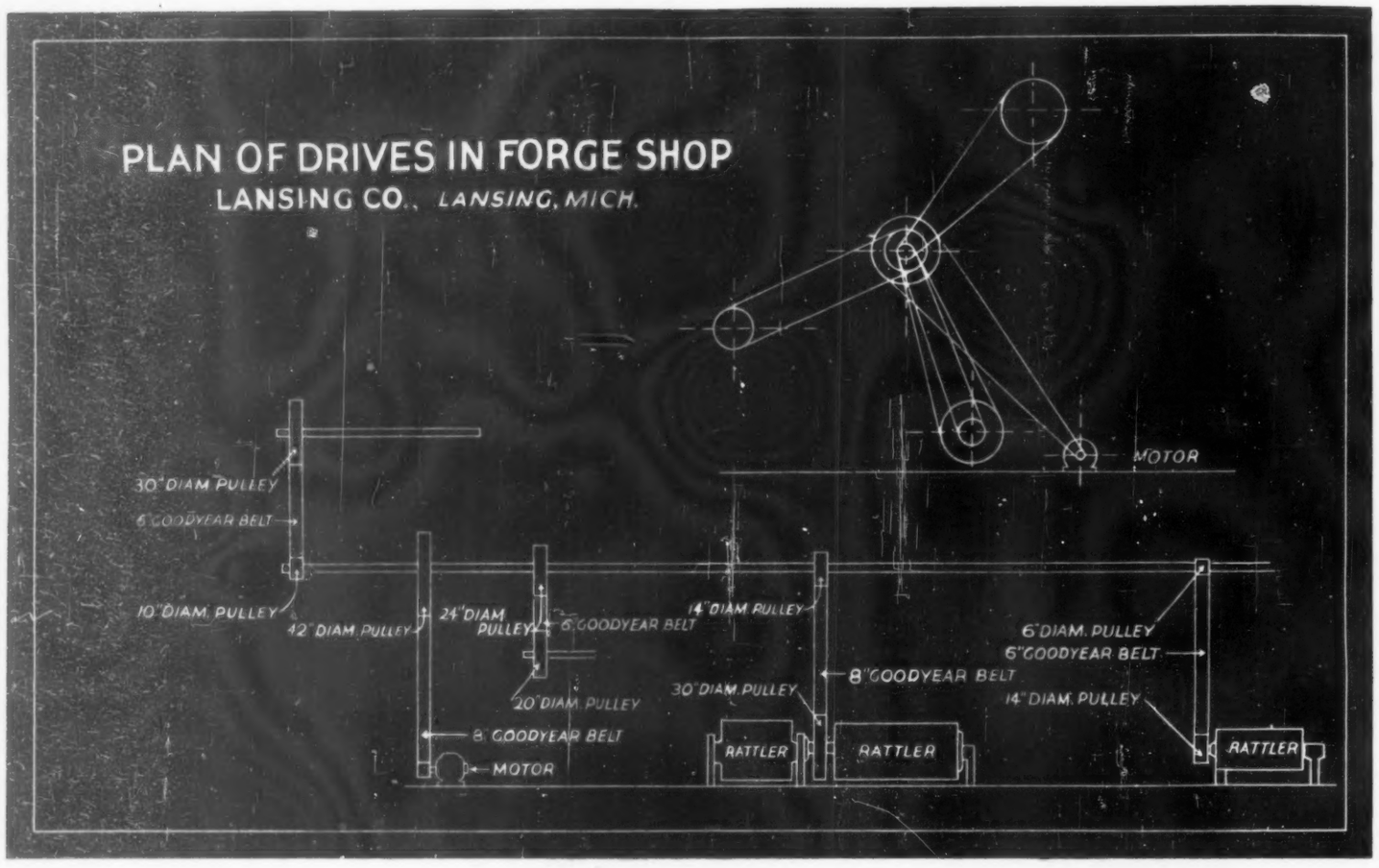


$11.66 Lower Price, $60.01 Lower Cost—and the G. T. M.

One day in the summer of 1917 a G. T. M.—Goodyear Technical Man—called on the Lansing Company in Lansing, Michigan. He explained the Goodyear Plan of selling belts, of making a diagnosis of the conditions surrounding each drive and then prescribing the proper belt to meet those conditions. It seemed to him that the men he talked with rather thought that his belts must be very high priced.

But they showed him a motor drive, operating a line shaft, on which a double belt generally gave only six or seven months' service. He studied that drive, noted the excessive heat of the forge-shop in which it was, noted the presence of grit and dust, made his measurements of power, speed, distance between centers, pulley sizes and the like. Then he prescribed an 8-inch 5-ply Goodyear Belt of Blue Streak Construction.

The price was lower by $11.66 when compared with that of the belt then just about giving out. So they thought they might as well give him a trial order. The belt came and was installed August 9th, 1917.

In spite of the heavy duty drives from the line shaft — drives operating rattlers and an elevator for hoisting iron to the foundry—it gave them a trouble-free service that they had never hoped for before. And it lasted seventeen months — although its price was $11.66 lower than that of the seven months' belt.

Price is what you pay for an article; its cost is what you get out of it. The old, expensive belt was priced at $33.88 in the summer of 1917. It cost $4.84 per month for its seven months' life. The Goodyear Belt specified by the G. T. M. was priced at $22.22 — and cost $1.31 per month for its seventeen months' service.

Its cost was $3.53 less per month — $60.01 less for the seventeen months. But long before it was worn out, the G. T. M. was asked to analyze another drive, one from the line shaft to a pair of rattlers. He specified an 8-inch 5-ply Goodyear of Blue Streak Construction. After it had been operating sixty days, the superintendent was so well pleased with its greater efficiency and freedom from trouble that he ordered another according to the G. T. M.'s specifications, and later still another; by Jan. 10th, 1919, there were five Goodyear Belts in the forge shop alone.

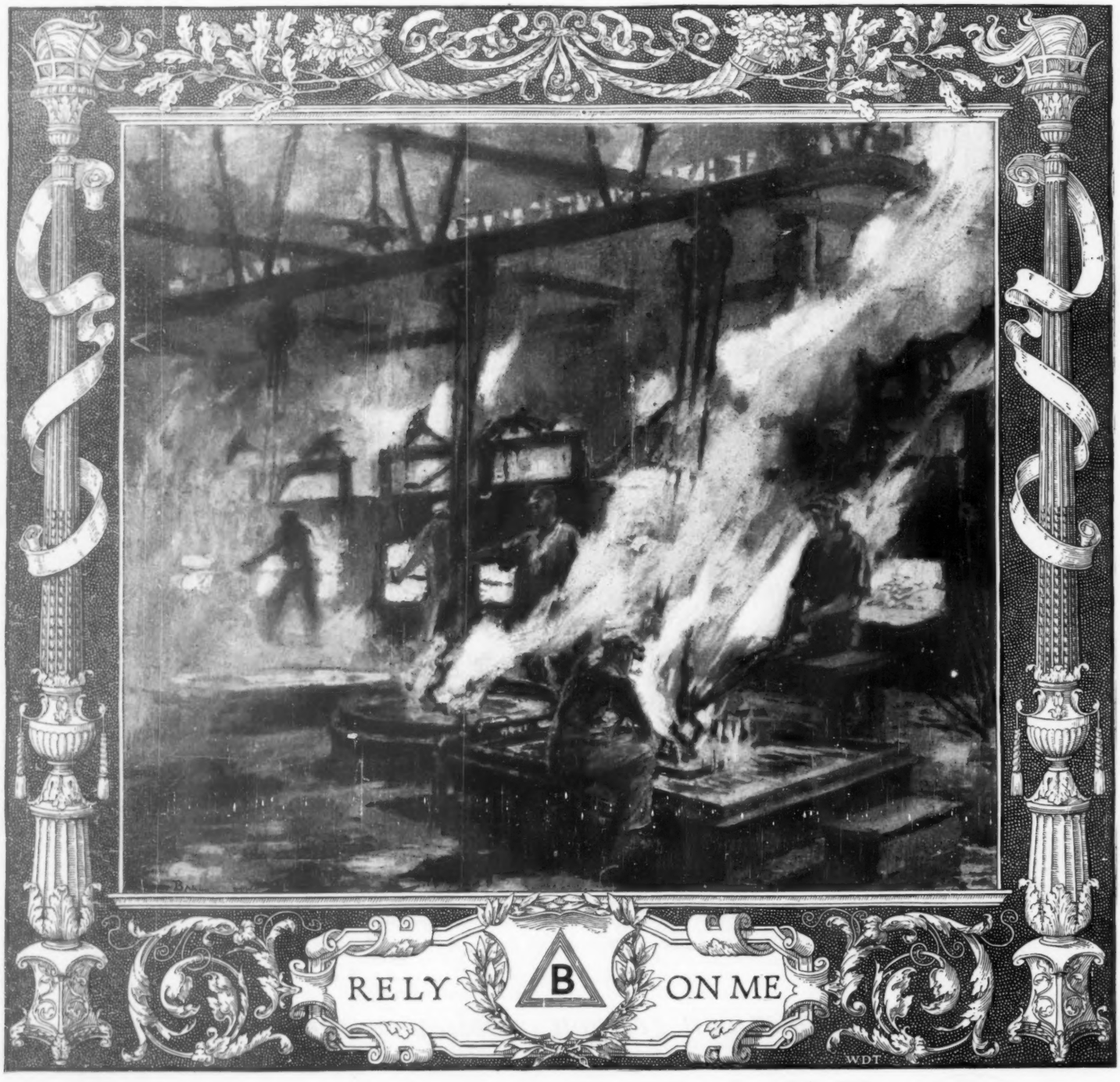
If you have a belt-eating drive in your plant, send for a G. T. M. In most cases he can save for you both in price and cost. His services are free, for the business sure to result within a few years more than pays for our investment in having him study your drives and specify the right belt to meet your conditions. If you ask for one to call, he will do so when he is next in your vicinity; but if your problem is pressing, there is one in a Goodyear Branch near you who will gladly make a special trip.

THE GOODYEAR TIRE & RUBBER COMPANY, AKRON, OHIO

BELTING · PACKING · HOSE · VALVES

GOODYEAR

AKRON



THE man who tempers a BILLINGS & SPENCER die performs a task of infinite delicacy. He builds high character into steel. His craft goes beyond mere knowledge—it is work no machine can perform, no instrument gauge. The rightness of the Triangle B die passes inevitably to the Triangle B forging. In steel, as in men, character begets character.

SEVENTY-FIFTH YEAR

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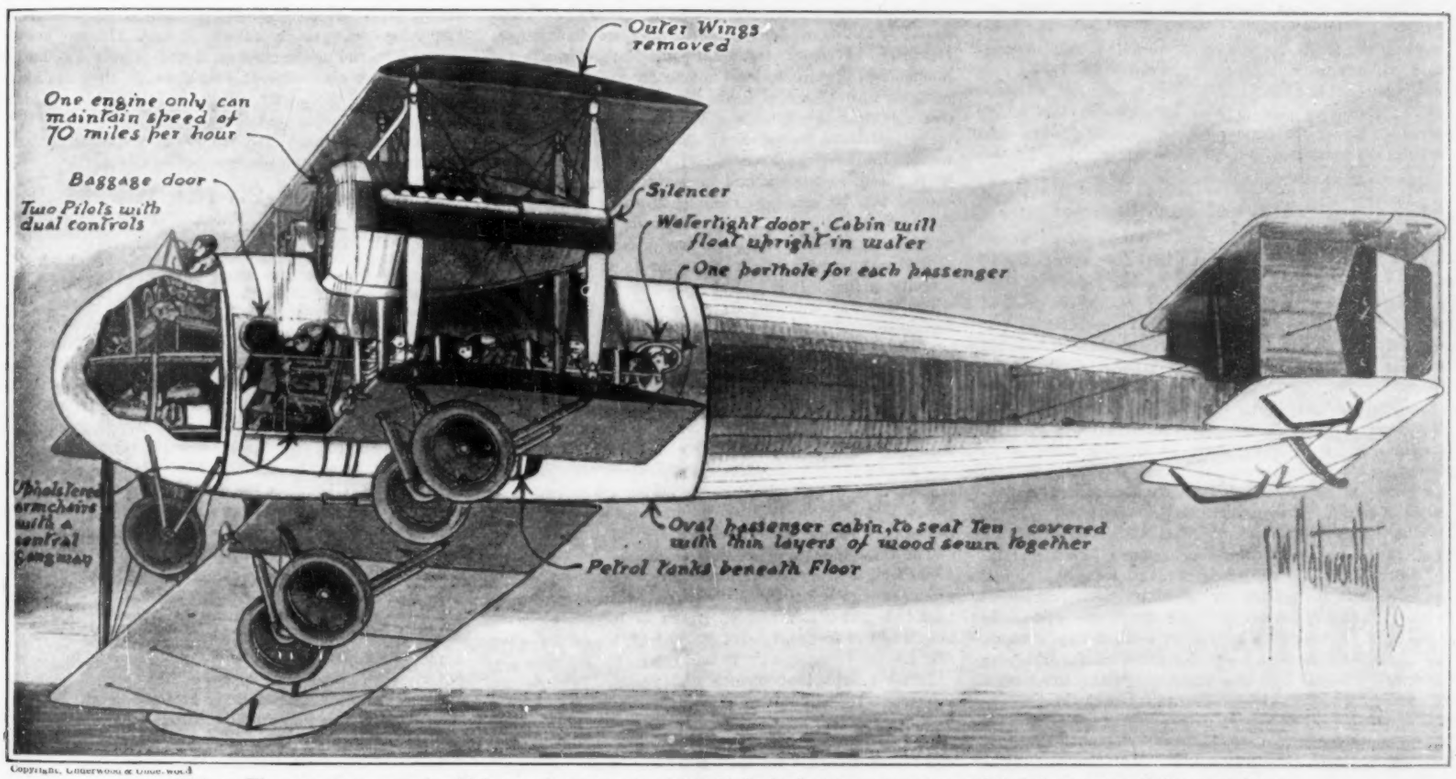

Vickers-Vimy passenger-carrying biplane as it appears in flight with its load of ten passengers and their baggage, and the crew of two

Airplane Passenger Service of Today

THE aeronautical industry is now going through its period of reconstruction. During the war all airplanes were talked of in terms of speed, climbing ability, maneuverability, bomb-carrying capacity, armament, and other expressions of warlike intentions. But today, with the great war at an end, and after satisfying the comparatively light demands of the military establishments of various countries, all thoughts are being directed toward passenger-carrying, cargo-carrying, and mail service.

Bombing planes are most susceptible to conversion into peaceful planes. Thus the great bombing planes of all leading countries are rapidly being converted into passenger- and cargo-carrying machines. Typical of this activity is the accompanying illustration of the passenger-carrying Vickers-Vimy biplane, which in general design differs but slightly from the Vickers-Vimy bomber of the great war. As a war machine, the Vickers-Vimy bomber carried a crew of four—a gunner-bomber, a pilot, a mechanic, and a rear gunner. When the same type of machine was prepared for the trans-Atlantic flight of Alcock and Brown, the space ordinarily given over to bombs was taken up by extra fuel tanks. In the more recent commercial model, the body has been somewhat altered so as to provide ample room for 10 passengers, while the two pilots sit up forward in a cockpit, all as shown in the accompanying illustration.

The seats for 10 passengers are arranged after the fashion of a railroad coach, that is to say, on either side of an aisle. Baggage is stored up front, under the pilots. There is a porthole for each passenger. Access to the passenger coach is gained through a watertight door, as indicated. The cabin will float upright in water, so that there is no grave danger if the machine is forced to alight on a river, lake, or sea. The engines are provided with silencers, in order to enhance the comfort of the passengers. Most remarkable of all, perhaps, is the fact that the machine can maintain a speed of 70 miles per hour with only one engine in operation, whereas the speed is somewhat better than 100 miles an hour with the two engines running.

Photographs recently received from Germany indicate that the German aircraft constructors are going right ahead with their peace plans. The huge Zeppelin bombing planes are being converted into passenger carriers, very much after the fashion of the machine here shown. In France the Caudron and Farman bombers have been converted into passenger carriers, the Farman "Goliath," in particular, representing an interesting case of French aviation reconstruction. The "Goliath" is engaged in carrying passengers between Paris and Brussels, on a regular schedule, and the air line is being patronized by French and Belgians alike.

So it is evident that the day of the airplane passenger service is here. The excellent performance of the airplane in the late war, considered as a whole, has convinced the world at large that there is little danger in the present highly developed airplane. Indeed, there are numerous aviators in the United States today who have gone into the business of taking passengers aloft for a modest remuneration. Some of these aerial establishments do a flourishing trade on Sundays and holidays, taking up one passenger after another for a 15-minute flight, while a long line of waiting patrons indicates the ever growing popularity of flying. In fact, it is the overcoming of the heretofore prevailing fear on the part of the public that has proved the greatest detriment to airplane passenger service, and how that this fear is definitely shattered, there seems no obstacle to progress along these lines.

How Insects Lower Milk Yield

A FACT not fully appreciated even among farmers is the economic loss in milk production caused by mosquitoes and flies. An Ohio dairyman owning 20 cows devised a home-built fly trap, and after it had been in operation a week calculated the difference in milk production. He was obtaining 11 gallons a day more than when the flies were unrestricted in their pernicious activities. In low-lying localities where insects have favorable breeding conditions, the late spring mosquito scourge is sometimes so bad as to destroy the profits in milk production. Some farmers use home-devised traps, as did the Ohio dairyman. Some wash their herds with preparations, manufactured commercially, which effectively reduce the pest. But the great majority of herds continue to go through the fly season protected against flies only by the weapon with which Nature equips them—the tail—and an inefficient weapon it is, too, beside what the dairyman can furnish. The cow which spends the entire day fighting flies does not consume the roughage needed for maximum yield at night.

The Ohio man built a lean-to, through which the herd passed. Across it in the middle were flexible curtains fitting closely about the cow which brushed the flies off. The dairyman following closed both doors, leaving the flies to cluster on a window, where they were quickly shot to death with a fly powder.

Did the cattle appreciate this device? Indeed they did, to such an extent that they soon learned to go through it without driving.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Thrift and Sunlight

WE hardly need to remind our readers that the SCIENTIFIC AMERICAN has been staunchly in favor of the Daylight Saving Law. In fact, our last editorial, favoring this law, was on the press at the very time that Congress passed the repealer. It seemed then as if we were doomed to return to the old standard of time, but President Wilson, coming fresh from Europe, where daylight saving has proved so successful and has been universally approved, took a broad view of the situation and very wisely put his veto on the repealer. There would be nothing more for us to say on the subject were it not that opponents of this measure are endeavoring again to force the abandonment of so-called "summer time."

The SCIENTIFIC AMERICAN has taken its stand on daylight saving, only after mature thought and careful consideration of the subject from all angles. It is almost impossible to inaugurate any great public improvement without inconvenience or even harm to some. In coming to a final decision for or against any measure we must consider not only the numbers favorably or adversely affected, but also must weigh the advantages it offers against the disadvantages. The injury to the minority may be so serious as to offset the advantage to the majority. We have had this in mind in considering the daylight saving problem. The chief opposition to the measure has come from the farmer, who we must admit, has been inconvenienced by having to set his clock forward in the summer time. His arguments have been well represented in Congress and it cannot be denied that there is something to be said in his behalf; but we fail to see that his inconvenience is so great as to outweigh the advantages of the other nine-tenths of our population. Nor are all the 10 million farmers of this country adversely affected by "summer time." Many farms are a community in themselves. They are not so closely tied up with city schedules or with train schedules that they must needs change their clocks. They can set their own rising hours and their own hours of work, regardless of the hours of work in the cities. The farmer argues that if the city man wishes to rise earlier he is perfectly welcome to do so, without disturbing the clocks of the whole nation. Evidently he does not realize the complexity of urban life; how impossible it is for any class of an urban community to change its time without upsetting the hours of others in the same community. Also he forgets that if a community is to rise earlier it must breakfast earlier, and hence the very farmer who supplies the breakfast table and the early morning market would have to rise earlier too, regardless of the clocks. Much has been made of the fact that the Labor Convention at Atlantic City was not favorable to daylight saving, but, as a matter of fact those workers most affected by the Daylight Saving Law are clerks who have no representation in any union and dwellers in congested sections of large cities who have no means of expressing their views as a body. It is true there have been some objections even from these quarters. We have read letters from individuals, whose principal recreation consists in going to the theater, and who feel that when they go down to the Great White Way in broad daylight they are missing something, if the lamps are not lighted. Evidently our city people must be educated to use their hours of recreation out-of-doors.

Such, in brief, seem to be the main arguments against daylight saving. However, among the *pros* and *cons* there is one factor which has not received as much attention as it should and strangely this was the very argument that gave us daylight saving in the first place. America has always been considered a very wasteful land. We have never tried to save, where saving caused inconvenience. The idea of thrift has not been born in us and it was not until the great war forced us to some measures of economy that we realized how prodigal we had been. It was the scarcity of coal that induced us in the first place to try the experiment of daylight saving. Last year considerably over one million tons of coal was saved by the mere expedient of turning the clock hands. Our store of coal is not limitless. Nature is not replenishing the store, at least not nearly as fast as we are using it up. Our coal fields are an inheritance which does not draw any interest. We cannot live on the interest and leave the principal alone. Every ton of coal we take means so much loss of capital, a loss which cannot be replaced, and it will not be many years before that capital will be seriously diminished under the growing demands of civilization. The anthracite of this country will be exhausted within but a few decades. A million tons of coal per year is no insignificant item in the present scarcity of fuel. It is just as necessary today as it was when the war was on, to preserve this precious inheritance.

The Thousand-Foot Ship

SO at last we are to have a thousand-foot ship, or rather two of them. The Shipping Board, through its energetic Chairman, is responsible for the announcement that two ocean liners, exceeding in length, size, speed and accommodations any vessel that is now afloat, are to be at once laid down by the United States Government and pushed through to completion.

The dimensions are certainly impressive; a length of 1,000 feet, a beam of 102 feet, a draft of 35 feet and a gross tonnage of 55,000 tons, will place these vessels well ahead of the "Leviathan," which is today, with its length of 950 feet and beam of 100 feet, the largest ship afloat.

If we except that phenomenal vessel, "The Great Eastern," the growth in size of trans-atlantic liners, during the past 80 years has been remarkably even, with few fluctuations. The "Britannia" of 1840 was 215 feet in length. Fifteen years later in the "Persia," a side-wheeler, ships had reached a length of 385 feet. Three years later, in 1858 came "The Great Eastern," 692 feet long, which in its time was one of the seven wonders of the world; but in 1862 the length had gone back to less than 400 feet. In the middle seventies the "Bothnia," 435 feet long, was a notable ship. Ten years later, in 1884, the "Umbria," 525 feet in length, achieved the high speed for those days of 19.6 knots. "The Paris," 560 feet in length won the "blue ribbon" of the Atlantic by crossing at 20.7 knots. Then the "Kaiser Wilhelm the Grosser" lifted the speed to 23 knots and the length to 649 feet.

The first ship to exceed the "Great Eastern" in length was the "Oceanic," 705 feet long, which made her maiden voyage in 1889. Seven years later those famous turbine ships the "Lusitania" and the "Mauretania," 790 feet in length, began to make phenomenal speeds, the climax of which was reached when the "Mauretania" crossed to the eastward at an average hourly speed of 26.01 knots.

The era of extremely long ships began in 1911, when the "Olympic," 883 feet in length, was placed in service. Three years later, the "Imperator," the first ship to exceed 900 feet, steamed into this port, and she was followed in 1914 by the "Vaterland," now the "Leviathan," with her length on deck of 950 feet.

The most remarkable characteristic of the two Shipping Board vessels will be their speed of 30 knots. This will be the greatest increase in speed ever made in a single advance. It is rendered possible by the recent improvements in turbine engines, and it is expected that 110,000 horse-power will be sufficient.

The most striking feature in the two great ships is, of course, their high speed. At no time in the 80 years of steamship travel across the Atlantic has there been such a jump in the speed as is promised for the new Shipping Board vessels. The greatest previous advance occurred between the "Deutschland" of 1900 and the "Lusitania" of 1906. The former made a crossing to the eastward at 23½ knots and the "Lusitania" raised this mark to 25½ knots, an advance of two knots. But the 1,000-foot ships are to have a sea speed of 30 knots, an advance twice as great as any in the history of ocean travel.

Mr. Hurley expects to get 30 knots out of these 55,000-ton ships with turbines of 110,000 horse-power. Only once has so great a power been installed on a ship, and that was on the battle-cruisers "Repulse" and "Renown" built during the war. These vessels made 32 knots; but they were small compared to the proposed 1,000-foot vessels, being only 794 feet long, by 90-foot beam, 25½ feet draft and 26,500 tons displacement. The "Renown" made 32 knots with 112,000 horse-power; but the new Shipping Board vessels will be of over twice her displacement, and although they will have the advantage of greater length, and, possibly, of finer model, it is probable that the towing tank tests will call for considerably more than 110,000 horse-power, if these ships are to maintain a sea speed of 30 knots.

Benjamin Franklin Took This Risk

Scranton, Penn., July 27th.—While emulating Benjamin Franklin late yesterday, Andrew Loyak of this city, was killed when a bolt of lightning followed the wet kite string from the skies.

Loyak was struck in the back of the head. Death was instantaneous.

THE above news item in the New York *Times* of Monday, July 28, 1919, affords material for laying proper emphasis on the great danger attending modern kite flying whether during thunderstorms or at less obviously dangerous seasons. Our natural desire to emulate the great scientist and statesman referred to, must be tempered by the more modern knowledge that Franklin's classic experiment was a very foolhardy one—though he did not know it. Franklin purposely sent his kite up into an approaching thunderstorm condition, but we now know that a kite-string raised to a considerable height in the air is an excellent collector of what is known as atmospheric electricity which is always present in greater or less amount and many days, not recognizable as thunderstorm days, would send down a strong current along such a kite string.

Today we have on sale in all toy stores modified patterns of what is known as the box-kite, a type capable of attaining very considerable altitudes and thus converting its string or its wire attachment into a large collector of static electricity. Our meteorological kite-flyers use large-sized box kites held by fine piano wire and therefore would run the greatest danger from shocks and lightning strokes. They know this, have repeatedly seen the thin steel wire go up in a streak of rusty smoke, and therefore are very careful never to neglect making a very good "ground" from the reel or wire carrier to the wet soil where they must be to work the kites. The fliers themselves keep as dry as possible and avoid contact with the wire or string. Instruments devised for measuring the potential on the kite wire frequently indicate high voltages and a little spark gap in the circuit would show an almost constant flow of current from the kite and the wire through the reel into the ground. As hinted above considerable shocks have been experienced by the curiously inclined on perfectly clear days.

By virtue of the carefully effected grounding and personal insulation such casualties as the above are today practically unknown among those who fly great kites day and night to much greater altitudes than those to which the average small boy can send his kite. Franklin took no such precautions, but deliberately exposed his knuckle to the spark which jumped from the key on his kite line and passed through his body to the ground. His escape from as speedy a death as we record is perhaps a proof of a discriminating Providence of those days; but no future Franklin need be lost by taking any such risks today. Better cut the string and lose the kite rather than persist in handling a wet kite string with bare hands while standing on rained-soaked ground. If you use a reel for the kite-string be sure to ground it as carefully as you would *any other lightning rod*, stand on dry ground yourself, and leave the string alone.

Electricity

New Peruvian Wireless Station.—The Minister of Public Works of Peru has informed the public that the new wireless station at the port of Eten has been opened for business. This station is now in communication with the large wireless station at Lima (San Cristobal) and at Iquitos, a town situated in the headwaters of the Amazon River. The Eten station is open night and day.

Electrical Help for the Glazier.—It has remained for a new company to introduce a device which is bound to prove a great boon to glaziers and others engaged in handling glass windows of all kinds. The new device is in reality an electrically-operated putty router, which serves to remove putty from all styles of glass windows, rebabbets the sash and makes a clean cut, removing points at the same time in one operation. It is compact, portable, quickly adjustable, and can be attached to any lamp socket. The router is operated by a 1/12 horsepower universal motor, with a speed of 12,000 revolutions per minute, and is instantly controlled by a push-button switch. A grinder wheel can be placed on the arbor by removing the cutters, and serves to grind the latter.

Conversion of Direct to Alternating Current.—In a recent article published in the *Revue Generale de l'Electricite*, Mr. O. L. Gotti discusses the various methods that have been proposed for converting alternating to direct current and vice versa, without the use of commutators. The principle on which such devices are based is the alteration of the self-induction of a closed circuit; a device is described utilizing moving brushes which respectively increase and decrease the flux through the primaries, so that the E. M. F.'s in the secondary circuits are additive. Moving brushes may be avoided in various ways, *e. g.*, by winding wire from one primary to another (a process hardly practicable), or by moving an armature along the magnetic circuit so that the reluctance of one circuit is increased while that of the other is being diminished. The latter is the more interesting device and the author suggests several forms of motors based thereon.

Decomposition of Liquid Dielectrics by the Electric Arc.—When electric discharge is produced between electrodes immersed in a liquid insulating material the initial breakdown of the dielectric requires a high potential difference. Afterwards the discharge can be maintained by a lower pressure. Messrs. E. Urbain and Clair Scal, in a paper presented to the Académie des Sciences, describe some experiments made with a Tesla transformer. In studying the liberation of gas, occasioned by arc discharges, the temperature of the dielectric should be low, as otherwise unduly violent reactions occur. Tetrachlorides yield chlorine, saturated hydrocarbons, acetylene, ethylene and hydrogen, etc. Whereas the decomposition of oils by discharges undertaken by Grignard at Pittsburgh involved a pressure of 10,000 volts, Urbain used 1,000 volts only for the rupture and from 500 down to 110 volts for the subsequent arc discharge. Metallic electrodes should be used, otherwise carbon would deposit from organic compounds thus forming a bridge between electrodes.

Telephone System for Czechoslovakia.—The Republic of Czechoslovakia (comprising Bohemia, Moravia, Silesia, and Slovakia) plans to remodel, enlarge and reequip its telephone system. For this purpose a mission consisting of representatives of the Department of Post, Telephone, and Telegraph, and experienced engineers will be sent to the United States to study and report on the various systems, switchboards, apparatus, appliances, etc., and recommend what in their opinion would best suit the conditions in the new republic. The United States with its network of telephones is recognized as positively the best field for such research, the ultimate object of which is to place contracts for a complete and thorough telephone system, providing service not only for the territory of the Republic, but also taking care of its needs as the leading country of Central Europe, through which runs the great trunk line of railway connecting Hamburg, Prague, Vienna, and Trieste, and where important development of waterways and railways is destined to take place in uniting the North Sea countries with South Poland and the Ukrainia, the upper Elbe and Oder with the Danube, and Czechoslovakia with Hungary, Roumania, and Jugoslavia.

Science

An American Medical Center in London.—A large fund has been raised for establishing an institution in London that will serve as headquarters for American medical men when visiting that city and also promote relations between British and American medical men. It is to consist of a hospital, library, lecture theaters and demonstration rooms, reading rooms, etc. Lord Reading is said to have accepted the presidency of the scheme.

Mr. George K. Cherrie, the naturalist and collector who became popularly known through his participation in Roosevelt's South American expedition, has recently returned from his twenty-eighth expedition to tropical America. His latest journey was to Venezuela, and he traveled alone, except for an attendant, living for weeks at a time on the native diet of corn and goat's milk. He has brought 800 specimens of birds for the American Museum of Natural History.

Apparatus for Measuring the Growth of Trees has been described by Mr. A. Mallock in the *Proceedings* of the Royal Society of London. An invar tape is passed around the tree and over the "rockers" on the apparatus, the arms of which control the angle between a plane glass surface and the face of a right-angled glass prism. The growth of the tree continually alters this angle, the variation of which is measured by observing the change of position of the interference bands formed, at grazing incidence, between the plane and the prism.

International Arctic Observations.—In the year 1914 plans were made for carrying on simultaneous observations in meteorology, aerology, terrestrial magnetism, etc., at a chain of stations around the Arctic Ocean, in coöperation with similar observations to be made by Roald Amundsen during his contemplated north polar drift. Now that Amundsen has at last undertaken his journey, the above-mentioned plan has been revived, and the Norwegian Government is seeking the coöperation of various countries, including the United States; also of other arctic xpeditions. It is hoped that observations may be begun n 1920, if not sooner.

Utilization of Wool-Scouring Wastes.—According to the U. S. Bureau of Chemistry there are approximately 500,000,000 pounds of unscoured wool used in this country annually. This contains about 75,000,000 pounds of wool grease, worth normally $2,250,000 (at the present time, $10,000,000), and 25,000,000 pounds of potassium carbonate, worth normally $750,000 (at present, $15,000,000). Practically all the potassium carbonates and the greater part of the wool grease are allowed to waste. The former is urgently needed in glass and soap manufacture, while experiments of the Bureau of Chemistry have shown that wool grease is one of the most effective materials for waterproofing shoe leather. The Bureau has been working on plans for recovering these valuable materials, heretofore almost entirely wasted. An additional object of this undertaking is to prevent the pollution of streams now occasioned by running the scouring wastes into the rivers.

The Gegenschein as an Atmospheric Phenomenon.—The gegenschein is defined in a recent dictionary as "the large, faintly luminous patch on the ecliptic opposite to the sun, supposed to be part of the zodiacal light; its explanation is still uncertain, though it is generally believed to be due to refraction from minute meteoric particles at a distance greater than the length of the earth's shadow." According to a hypothesis set forth some years ago by Moulton, the gegenschein may be due to a swarm of meteors which, on theoretical grounds, might be expected to accumulate some 930,000 miles outside the earth's orbit, owing to the attraction of the earth, moon and sun. According to Evershed, the earth has a tail like a comet, which gives the appearance of the gegenschein. Prof. E. E. Barnard, in a recent article, expresses the opinion that this glow is really due, in some way, to a concentration of the sun's light by refraction in the atmosphere, as if the latter acted as a spherical lens. It would, according to this view, fall into the same category with twilight phenomena, and belong to the domain of atmospheric optics rather than astronomy. There is, however, says Professor Barnard, one objection to this hypothesis; viz., that the gegenschein seems to be much elongated, rather than round, and this apparent elongation repeats itself each year at about the same time—in the latter part of October.

Aeronautical

High Flying with Twenty-five Passengers.—At Toussus-le-Noble on May 5th the Farman "Goliath" with 25 persons aboard, ascended to a height of 5,100 meters (16,600 feet), the climb taking 1 hour 15 minutes, while the descent was made in 25 minutes. Lieut. Bossoutrol was the pilot.

Commercial Aerial Transportation in Texas.—As an example of what can be done with cast-off military planes, there is a commercial aerial transportation service now doing business in Texas. The ship used is a Canadian Curtiss JN-4, which, according to the pilot, has been purchased from the Canadian Government at a cost of $2,000, complete with two spare propellers, two cylinders, tools, and other minor spare parts. It is understood that in the first month of operation, during which money was derived from taking up passengers, the revenue more than paid for the ship three times over. Companies of this kind are springing up through the United States, and numerous ex-Army fliers are said to have received invitations to join such organizations.

Second-Hand Army Planes.—A few weeks ago the Curtiss organization closed a deal with the U. S. Government for the purchase of 2,176 Curtiss airplanes and 4,608 motors used in the Army. It is understood that the amount of money involved in the transaction was $2,700,000. Speaking of the transaction, an official of the Curtiss organization had the following to say: "The airplane is still in its infancy, and it will be some time before the industry will be a paying one. We were faced with the serious task of keeping our vast organization intact until the public realizes the business possibilities of aircraft. We felt we were thus compelled to bid for the Curtiss make planes and engines, which the War Department announced it would sell, in order to protect our market and keep the Government from selling to the public machines, many of which were unfit for operation without overhauling. Practically all of the planes have had strenuous use. We realized if we were going to continue in the airplane industry we had a duty to perform to the public in preventing used planes from being marketed until put in the proper condition."

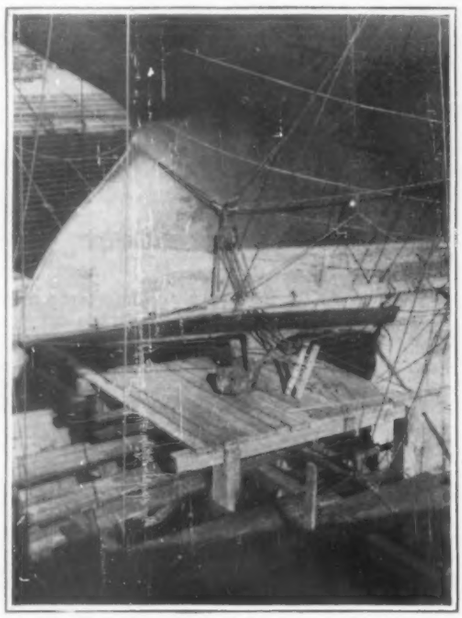
The Apron Screen of London.—The Royal Commission on Awards to Inventors, Mr. Justice Sargant presiding, on May 26th, heard evidence in a claim by Dr. Prassone, Director of the Italian Aeronautical Instruction Department, and Major Avorio, a major of Engineers in the Italian army, as joint owners of a patent for a kite balloon used in the "apron screen" used in the defence of London. It was stated that the balloon was spherical and had a conical appendage, which had three further attachments known as stabilizers. The balloon itself was filled with hydrogen and the appendage and three stabilizers were filled with air. The balloon came into use only a comparatively short time before the end of the war. The advantages claimed were lifting power, stability, and steady rising due to two of the stabilizers being inflated before it left the ground. It was stated that the "apron" defence of London consisted of piano or other wire stretched between two or more balloons, and attached to this were piano wire streamers, meant to entangle enemy aircraft. No enemy aircraft had been actually caught in the "apron screen." In March, 1918, two balloons were brought from Italy for experimental purposes, and later Dr. Prassone and Major Avorio came to England. On April 16th Dr. Prassone was asked to make an offer. The question of royalty came up incidentally, but the real negotiations were about actual purchase. On April 17th Dr. Prassone wrote mentioning £80,000 as a proposed purchase price. The price of a 1,050 cubic meter balloon was £1,116, and the 2,000 cubic meter balloon cost £1,823. The government had bought three of the smaller size and 20 of the larger, the cost being roughly £40,000. Apparently only nine had been delivered. On the question of a royalty basis, it was stated that 15 per cent had been suggested by the claimants at a time when a much larger use was contemplated. On the basis of £40,000 spent, it was submitted by the Crown that the royalty should be five or seven per cent. For the claimants it was urged that in any event the royalty ought not to be less than 10 per cent, together with an agreed sum of £500 for expenses. According to the testimony brought out at the hearing, a similar scheme of anti-aircraft defense was suggested in 1913. No decision was reached.

Repairing the Stern-Frame of the "Northern Pacific"

The Largest Marine Weld Ever Made

THE readers of the SCIENTIFIC AMERICAN will recall the stranding of the Army transport "Northern Pacific" 300 yards off the shore of Long Island last January. The vessel was loaded with 3,000 passengers, many of whom were wounded soldiers. For a time it looked as if the ship would go to pieces under the pounding of the waves and as the winds rose the lives of the sick and seriously injured were almost despaired of. But by heroic efforts they were all taken off, with the aid of basket litters and the breeches buoy, and eventually the ship itself was worked off the sand by a fleet of tugs and towed to New York.

The vessel was put in dry-dock in the Brooklyn Navy Yard, and the injuries she received were investigated. A number of plates were badly damaged and had to be replaced. Her turbines were out of alinement and some of her machinery was disabled. The most serious damage the vessel sustained was in the stern-frame, which was cracked through. In fact it is a wonder that the stern-frame and rudder were not washed away in the storm. Only a slender stern-shoe connected the bottom of stern frame with the boat and this must have been subjected to a tremendous strain. It is probable that the stern-shoe was buried in the sand and was stiffened thereby sufficiently to withstand the shock of the waves. The rudder, however, received the full force of the waves and caused the break in the stern-frame.



Scaffold built around the broken part of the stern-frame

Burning out a 3-inch gap at the break in the stern-post

To replace the broken frame with a new one would probably have cost $50,000. The only other alternative was to weld it *in situ* by means of Thermit and although so large a weld had never been made in marine work there was the precedent of similar welds in steel mills, and hence the work of welding the frame was undertaken.

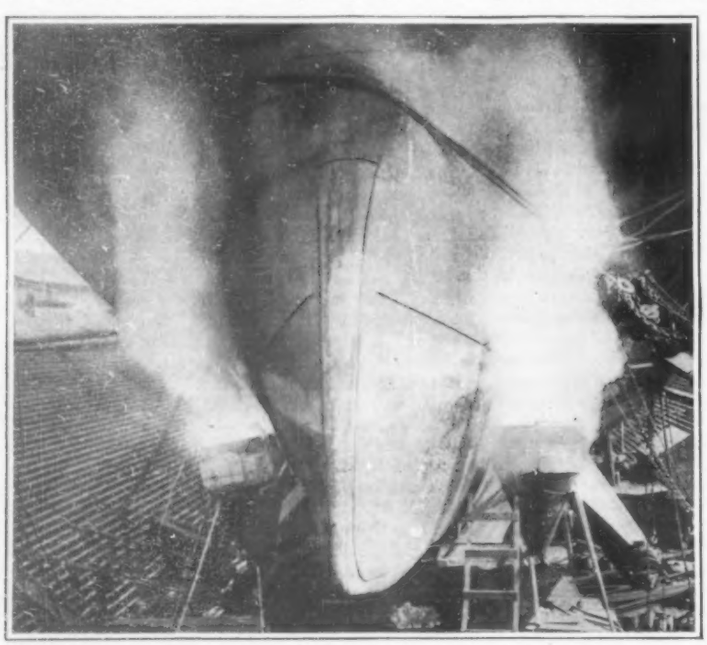
The operation was complicated by the fact that the break took place just above the uppermost gudgeon at a point where a hollow portion of the frame joined a solid portion. The first process was to cut away part of the frame so as to provide an opening large enough for the metal to flow in freely. A three-inch gap was cut in the casting by means of an oxy-acetylene torch. Just above the stern-frame there was a chamber in the vessel access to which was had through a hole about two feet in diameter used to accommodate the rudder stock stuffing box. When the rudder was unshipped it was possible to crawl through this hole and then, on cutting through the inner hull, to reach the hollow space in the stern-frame from above. The frame was lined with yellow wax and a layer of wax was placed on the hollow floor of the casting. A wooden cylindrical riser pattern led from the floor to the top of the casting. Molding material was then deposited in the casting and rammed up with a pneumatic rammer. This had a facing material of fire clay, ground fire brick and sand in equal parts. To keep the mold from dropping when the wax was burned out, iron gagers were inserted against the inside wall of the casting and bent inward into the mold.

The interior portion of the mold having been completed, wax was applied to the outside, and then a mold box was built up around the wax and filled with molding material.

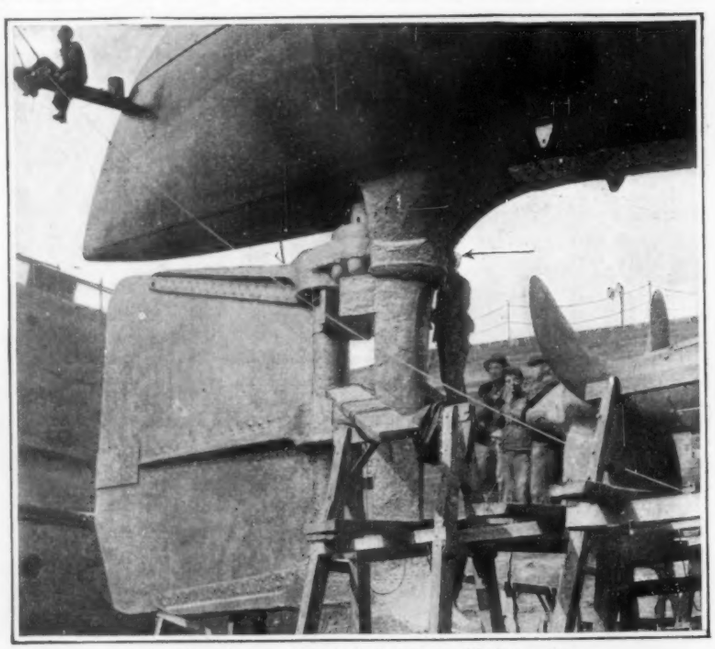
Heating gates were provided by inserting cylindrical wooden patterns through the bottom of the box on both sides and in the rear of the weld. Pouring gate patterns were connected diagonally downward through the top of the mold with the wax pattern. For outside riser patterns, a small narrow piece of a wooden plank was inserted close against each side of the triangular stern frame section and connected with the wax pattern below. These outside risers served the special purpose of supplying molten metal for the weld during cooling shrinkage and thus preventing the thin casting shell at this point from sloughing away. All wooden and pipe patterns were removed before preheating.

Two crucibles were now set in place. The mold was then preheated in order to dry it thoroughly and also to melt out the wax pattern. This was done with gasoline torches, and the preheating was kept up for seven hours, after which time the molded sections had developed a bright heat. Then the heating gates were plugged up and preparations were made for the Thermit reaction.

Thermit is composed of a mixture of aluminum and iron oxide. When ignited the aluminum combines with the oxide of the iron, leaving the iron free which is melted by the intense heat of the reaction. The temperature rises to about 5,000 degrees Fahrenheit. The crucibles were set off simultaneously by two men each of whom dipped red-hot rod into the ignition powder. The reaction was most spectacular. Our artist has endeavored to give some idea of it in the cover illustration. The intense heat resulted in a very brilliant pyrotechnic display which lasted for some little time. About 45 seconds were allowed for the reaction to take place, after which the crucibles were tapped allowing the molten metal to flow into the mold. The following day the mold was removed and the risers and gates cut off with an oxy-acetylene torch, thus completing the weld.



The brilliant reaction just before the metal flowed into the mold



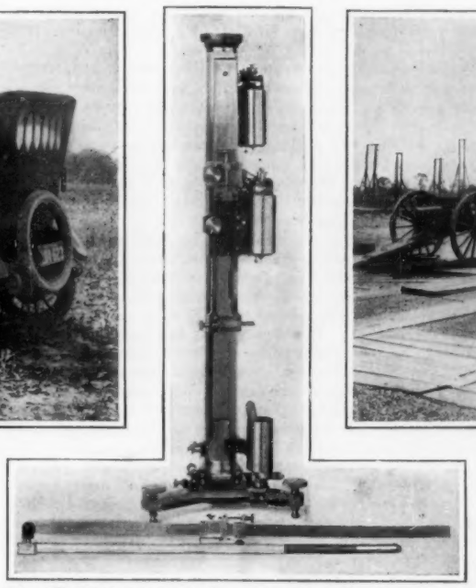
The stern-frame after it had been welded together

The Aberdeen Chronograph

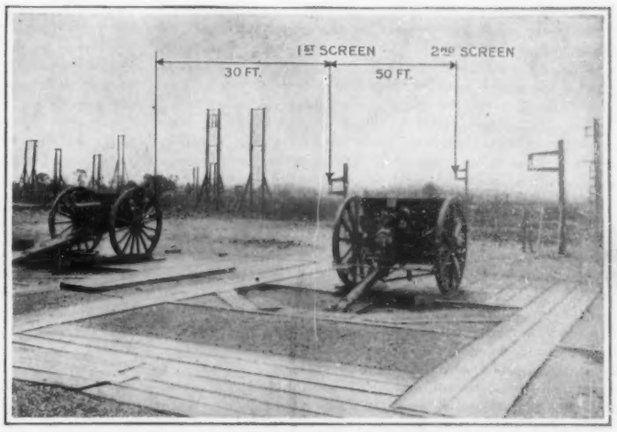
An Improved Device for Timing the Flight of a Projectile, Developed by the Army Ordnance Department

By Herbert T. Wade, Captain, Ordnance Section, Officers Reserve Corps, U. S. Army

Showing the portability of the Aberdeen chronograph



The "Fall" that helps to keep the chronograph accurate



The chronograph at work with a 75-mm. field gun

THE accurate and effective use of artillery, so evident in the recent war, means not only carefull drill and discipline for the gun crews, but the constant application of scientific knowledge and study from the firing point all the way back to the ordnance works, and particularly at the proving ground, which is the great ordnance laboratory.

In order to place the shot with the almost inconceivable accuracy now secured, the various characteristics and properties of the propelling charge, projectile, and of the gun itself, must be determined in advance with great precision, then standardized and reduced to tables for the rapid use of the gunners in the field. In making such tables and in other artillery studies, one of the fundamental elements that must be known is the velocity with which the projectile travels after leaving the gun. This naturally involves the measurement of a minute interval of time too small for any ordinary stop-watch to record, yet determined with laboratory precision. The design of the cannon, the nature, weight, and shape of the projectile, and the amount and kind of the propelling charge, all condition the velocity of the shell in flight, and any variation in one or more of these elements naturally affects the range, power, and general effectiveness of the piece. Consequently the determination of flight velocities is an important and routine performance of the proving ground, where guns, projectiles, and explosives are tested. This work today is done with increased facility and precision with a time-measuring instrument or chronograph developed during the war by the Ordnance Department of the United States Army, and known as the Aberdeen Chronograph, after the new proving ground at Aberdeen, Md.

The Aberdeen Chronograph is fundamentally different from the Boulenge Chronograph previously employed where use is made of the principle of the law of falling bodies. In the latter instrument a vertical rod is released by an electromagnetic device at the beginning of the period to be measured, and falls under the influence of gravity. At the end of the interval this is nicked by a knife point, also actuated by an electric magnet. The distance thus indicated on the rod corresponds to a certain fraction of a second as determined by calculation and experiment. It is applied to the determination of the velocity of projectiles by utilizing wire screens in the path of flight, where the rupture of the wires breaks an electric circuit connected with the release and recording mechanisms referred to above. Screens such as these are very familiar objects at proving grounds.

The new Aberdeen Chronograph, on the other hand, consists of a rotating drum maintained at a constant speed of revolution by an electric motor with centrifugal governor. It not only has greater accuracy and simplicity, but by the use of a direct reading scale the velocity of the projectile can be read direct from the record within seven or eight seconds after the observation is made. Furthermore instead of the wire screens placed in the path of the projectile, screens of lead foil and paper more readily provided and exchanged are employed. In these the passage of the shot does not break the circuit, but closes it by establishing connection between the two metallic surfaces on either side of a sheet of stout paraffined paper.

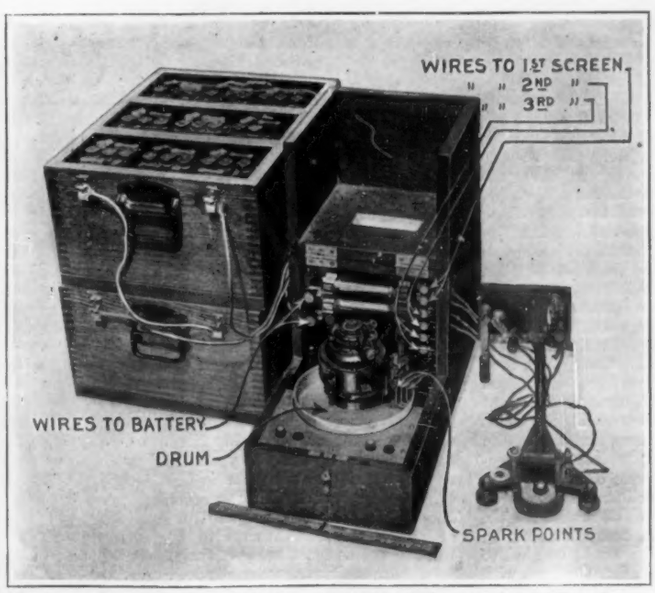
The general arrangement is shown in the accompanying illustration which shows a 75 mm. field gun employed in special proof work on the Aberdeen range. In front of the gun, on stakes set accurately 50 feet apart in the line of flight of the projectile, are placed the screens formed of paraffined building paper with lead foil or sheet tin strips on either side and connected by wires with the chronograph located either near the gun or possibly in a permanent instrument house. Each time a screen is ruptured the projectile completes the circuit between the opposite strips of foil. The time required for the projectile to travel the 50 feet between the screen is then indicated by two successive sparks which puncture a record strip on the rotating drum.

With the exception of the screens and the wires leading to the chronograph itself, no other appliances are needed than this instrument with its storage batteries and a few accessories contained in a small case. The storage batteries supply the current for the motor and the spark or induction coil.

The principal feature of the chronograph is a drum of cast aluminum whose circumference is 500 millimeters (19.685 inches) mounted on the shaft of a small series-wound 120-volt motor driven at the constant speed of 25 revolutions per second. Within this drum is placed a record strip of prepared wax paper which is held against the interior circumference by centrifugal force. When the motor is revolving at normal speed the circumference of the drum must have a velocity of 500 mm. × 25, or 12,500 mm. per second (492.12 inches or 41.01 feet). As the projectile in its flight pierces the first screen the circuit is established in the primary of the induction coil, whch induces a current in the secondary of sufficient tension to cause a spark to pass from the spark point to which one conductor of the secondary is connected through the wax paper to the drum itself with which the other conductor is grounded. In this way the record strip is pierced at the time the first screen is passed, and similarly the operation is repeated and a second puncture is made from a second spark point in a corresponding circuit when the second screen is reached by the projectile. The motor is then stopped, the record strip removed and the distance between the two punctures measured with a millimeter scale. Dividing this distance by 12,500, the velocity of the rotating drum or the distance traveled in a second, gives immediately the fraction of a second required for the passage from one screen to the second, a distance of 50 feet. Therefore dividing the time thus measured into 50 there is obtained the average velocity between the two screens. In practice none of these calculations is actually made, for a direct reading scale is laid on the strip and the velocity is read off immediately after the projectile is fired.

This instrument, which weighs but 45 pounds, is so portable that it can be set up anywhere in the field with the stakes driven into the ground in the

(Continued on page 145)



Lead foil screen of the Aberdeen chronograph, and the drum and electrical parts of the apparatus

Economic Tree Murder

How We Are Denuding Our Forests to Supply Europe While She Is Conserving Her Own Timber

By C. H. Claudy, Washington Correspondent of the Scientific American

IF a man possess one million dollars and spends of it 50 thousand dollars a year, at the end of 20 years he will be a beggar.

If he puts his million dollars out at five per cent interest, he may spend 50 thousand dollars a year and at the end of 20 years possesses just as much as he has now.

The farmer who reaps a field of wheat and never thereafter plants the land with anything will have in future only a crop of weeds. Only by rotation of crops and fertilization of the land can it continually grow the vegetable food we consume.

Few will quarrel with these statements. Yet the very man who will agree entirely with the statement that it is foolish to spend principal when the interest would pay the bills, who understands that land must be farmed, not left uncultivated if wheat is to be reaped, will cut his standing timber with absolutely no reference to the future. There are thousands of privately owned forests in America today which are being *mined*, not forested—natural resources which are being treated exactly as if they were deposits of oil, coal or mineral. Owners consider them as much personal property as if they were cash in the bank, and our shortsighted and inefficient governmental policy allows us to treat a renewable resource as if it were mineral wealth—not to be replaced by any human agency.

There has never been developed a substitute for wood which was as good as wood. True, we use concrete and steel for structures and thin steel or aluminum for furniture where formerly we used hard wood. But no material which we can produce can be so quickly taken from nature to market, can be so readily worked into finished products by hand, develops such strength with such lightness, or such ability to withstand strain, wear and decay. There is no substitute for wood for the thousand uses to which wood is put. Deliberately to destroy the wood of a country, then, without providing for the future, is an economic crime. Unfortunately it is only an individual crime, not a public crime, for when an act against the welfare of the whole people becomes known to the whole people, the whole people stops it. Today we are headed straight for economic destruction as far as our timber is concerned, *because we don't know what we are doing*—the great bulk of us. The few who own standing timber seem to act on the idea that "after me the deluge." Nor is the reson very far to seek. A man with a million dollars expects to live out his 20 years and wants his million intact—so he uses interest instead of principal. The farmer knows that by care he can plant and replant, reap and rereap, year after year. But the forest owner knows that it will take 50 or 60 years for him to reap if he sows now—and then he will be dead. So he reaps now, to enjoy the fruits of what he owns, regardless of those who will come after him and who must suffer for his prodigality.

In the meantime, the war has created an enormous demand for timber abroad—and we are developing an export trade in lumber which will put a lot of money in the hands of the exporters of wood, and the owners of forests. That money, so they argue, will come from the people of Europe or South America, so that, if we be poorer in lumber, we will be richer in dollars. Yet much of what we export will be used in factories which *will export their goods to us*—goods which we *could* make at home, and save *both* our lumber and the profit we thus pay to foreign industries. And finally, to meet the domestic and the foreign demand at the same time, we are cleaning out our forest resources at a rate which brings the end of our own wood using industries plainly in sight—not in the next generation, but in this one—not in the next 50 years, but well inside the next 20—and all because we have no government forestry policy big enough or broad enough to handle the situation.

Let no one take this statement as a criticism of the Forest Service of the Department of Agriculture—for all that the United States knows of forestry has been taught by this service and all or nearly all has been saved from the wreck of what was once the greatest industrial resource of timber in the world, has been salved by this service. But the Forest Service has no control over the private owner and no method of enforcing upon him the modern methods of forestry. A man who owned a coal mine and deliberately set it on fire, he who owned a big oil well and of malice let the product run to waste, would be so badly handled by public opinion if not the law that he would be glad to conserve what he then threw away. But the man with a forest who chooses to destroy it for all time for the present benefit of his pocketbook is not even noticed by the rest of us, too busy with our own affairs to care what he does with his.

Figures, as a general rule, are uninteresting. Statistics may vibrate with life and interest, but not unless someone translates them into a picture. Yet only figures will tell the story. The trouble is too often that figures are made so vast and all inclusive that the mind refuses to take them in.

So here let us consider for a moment, not the figures for the whole lumber industry or the whole world but those which are concerned with one kind of lumber only.

Southern pines, especially the longleaf pine, are the source of our naval stores, turpentine and rosin, the production of which is in excess of $20,000,000 a year. We produce more than any five countries in the world, our nearest rival—France—producing only one-fourth as much as we do. But France has her naval stores industry on a permanent basis—her forests are all under the strictest of government supervision. Even during the war, when France made calls on her forests she never would have made in peace times, her wood was cut with the strictest regard to modern forestry management and American engineers had to subscribe to and carry out her principles of forestry before they could obtain French lumber. At the present rate of deletion of United States longleaf pine, the turpentine and rosin output of this country is doomed to extinction in a very few years—France will continue her present output and probably increase it in the future, because she is conserving, not wasting—putting her wood out at interest, not using up the principal.

Of course, we have not yet slain our golden-egg goose. We can, right now, put our turpentine and rosin industry on a permanent basis, if we will. To do so, we must set aside some 20 million acres of longleaf pine land, averaging from two to three thousand feet per acre or from 40 to 60 billion feet of standing timber. If we do this; more, if we put *all* southern pine land on a government supervised basis, we could easily maintain our turpentine industry on a larger basis than it is now, get all the yellow pine lumber we need for domestic consumption and have almost 12 billion feet for export yearly instead of our present exportation of 1½ billion feet.

These are not guesswork figures. The present area under yellow pine in the South is about 124,000,000 acres. Fully stocked and carefully forested this will produce about 70 cubic feet per acre per year or over 27.5 bilion board feet per year.

Why don't we do it?

Here is one reason why. Europe wants timber and wants it badly. Europe is conserving her own timber (of which more in a moment). She isn't interested in our future, but in her own. We are interested in our present, not in Europe's future. So we are selling our principal to European countries, that they may conserve theirs, while we make a present-day profit.

Europe wants as cheap lumber as she can get. Hence she wants what we have in the east, not in the west, because it is cheaper to put southern pine on ships than it is to put western wood on the same ships. Consequently, about half our export trade of wood is this same southern yellow pine—and we are cutting it and sending it abroad at a rate which means that in *less than 14 years 99 per cent* of our own industries which depend on this wood, will go out of business. These are not guess-work, scare-head figures—they are sober statements from those most interested—the Southern Pine Association.

Consider for a moment what foreign countries are doing to conserve their resources—countries like New Zealand, which has passed laws restricting export of wood in order to protect domestic needs. Switzerland prohibits cutting of private forests except under government supervision—her forest owners cannot exhaust their principal if they want to. Europe would denude Switzerland of all her timber in five years if Switzerland would permit. She is wise and says "No." Sweden a natural exporter of timber, will not permit cutting, let alone export in excess of annual growth. In other words she proposes to use her timber as it grows and to have, a year, 10 years, 100 years from now, just as much as she has at present. She is glad to sell, but not to exhaust, her wood. Norway regulates private cutting, England is planning to plant nearly 2,000,000 acres and provide a forest reserve to meet domestic needs of three years at least, against the possibility of a future war. France is now enlarging her forest nurseries—and France was always chief among countries demanding careful forestry of her owners. All the timber exporting countries are conserving their resources—*at our expense*. Germany had found time in the midst of all her trouble to plant trees, especially black walnut trees (gun stock)!

There has been an enormous amount of newspaper, magazine, governmental and organization talk, propaganda and effort put forth to the end that the United States go forth and capture as much of the world's trade, after the war, as it could handle. And, of course, the lumber industry has felt the urge and wants to participate in the increase which a super-stimulated foreign demand will produce. It need have little worry that the demand is coming and coming fast. For few foreign users of wood but are importers of it not always because they haven't got it, but because if they possess it, their resources are undeveloped and inaccessible, as in some South American countries. Central and South America import soft woods from Canada, the United States and Sweden. Africa does not supply its own needs, much of her enormous forests being inaccessible to transportation. Egypt imports largely. China increases her import yearly and if China develops commercially as she appears to be going to do, her demands will be very large indeed. Far-off-Australia gets soft wood from Canada and the United States. New Zealand wants more hard wood. All Europe wants more hardwood, as a matter of fact, and wants it from us, for no other country produces so much or such good hard wood as we do.

We export, for instance, some 40 million feet of hardwood staves for cask, keg and barrel making. That is little enough, yet the stave making process is the most wasteful of all wood-working processes and few foreign countries permit the stave maker to exercise his art with fine local hard woods. Prohibition here may decrease the domestic demand for staves but our wood will still make kegs for Europe's wines and beers—for 25 years. Then our white oak will be exhausted and—we shall suffer, that Europe may have the kegged drinks we cannot have ourselves. Our yellow poplar will last 20 years at present rate of cutting, our back walnut 10 or 12 years. Hickory is already very scarce. Ash and oak cannot be obtained everywhere as formerly and some mills already report a famine.

What are we going to do about it?

Other countries are not so backward—they not only protect their own resources but they look to the United States to play the lumber fool and let them have what they need while they build up their own supplies. Oh, it isn't happy reading, but it is the truth. A government report from far away Cape of Good Hope says this: "Within the past few years the reckless improvidence and desire for quick returns practiced by Yankee speculators have placed hickory spokes and even ready-made American trolleys and buggies on the South African market and these have found purchasers—well-wishers of the Colony may, however, view this with equanimity, since it gives the more valuable hardwood forests a period of rest and recovering from the recognized mismanagement of former years, pending the inevitable ultimate failure of the American supply."

Henry S. Graves, Chief Forester, United States Forest Service puts the matter very clearly when he asks, "Is it a wise policy to attempt to develop extensive foreign markets for hard wood lumber at a time when our forests, as now handled, will be able to produce barely enough for our own industries? Is not such a policy bound to react unfavorably on our wood-using industries, by increasing the cost and diminishing the supply of raw materials, while at the same time supplying raw materials to competing industries in the countries to which we ship lumber? Even now, American lumber goes into imported automobiles, musical instruments, furniture, pencils and other articles, aggregating in value some $9,000,000 a year. In short, our forests are drained to support foreign factories in order that they may meet American needs for articles that might be produced here. Are we not by such a policy helping foreign industries and workmen at the expense of our own? Would it not be better to build up our own forests and provide an abundant and cheap supply of raw materials for our own wood-using industries by exporting only the surplus over and above our needs, instead of providing raw material for European furniture factories and other wood using industries when our own will have to go without or pay excessive prices? Obviously the answer is to stop the present forest destruction, and to produce by growth enough material both

(*Continued on page 145*)

The Failing Dollar

How Shall We Arrest the Decline of Its Purchasing Power?

By Alfred J. Lotka

THE paths of progress are varied.

One man's merit may be that he had the insight to profit by some chance observation or idea, which his fellow might have passed by without recognizing its significance.

Another man sets out deliberately to solve a problem presented to him in his daily work. Modern technical advance is made principally in this way.

But there is another type of progress, which involves, in a sense, the overcoming of more and greater difficulties than either of the two cases just mentioned. It is the type of progress which is the special task of the reformer.

For his task is threefold:

First, recognition and diagnosis of a condition calling for readjustment.

Second, the finding of a practical remedy.

Third, the carrying out of the reform in practice.

Of these three, perhaps the hardest is the third step, for it involves the overcoming of popular inertia.

It is this kind of a problem that confronts the economist today.

The diagnosis is, at least in part, effected. Our high prices are due, in part at any rate, to depreciation of money through cumulative increase in gold production and through expansion of credit instruments, as was pointed out in a recent article in these columns.

What, then, is to be the remedy?

Man is naturally conservative. He is not much disposed to question a system under which he and his forbears for many generations have grown up. He takes it for granted, as a fundamental fact of nature.

Yet, as M. M. Metcalf pointed out in his recent presidential address before the Ohio Academy of Science, the man who has learned to adopt a detached attitude can view popular customs as scientific phenomena to be appraised without prejudice. And "it is surprising to see how many of our important social customs, when so viewed, are without scientific warrant, are, indeed, absurd. One of the most absurd of social economic conventions is the adoption of a single metal as a medium of exchange, though this continually fluctuates like any other product. An essential feature in a good medium of exchange is, of course, stability in value, so that debts will be paid in dollars of the same worth as the dollars or other consideration received when the debt was contracted.

"In merely taking our most valuable abundant metal as a medium of exchange, as now, we are following without effort an old custom and are making no attempt to have our medium of exchange conform to the needs of society. Instead of attempting to solve the problem *we are accepting failure.*"

Picture to yourself the predicament of the retail cloth merchant whose yard stick were subject to unaccountable and uncontrolled variations in length, and who went on dealing out to his customers what he thought to be equal units of his ware, when in reality he might be measuring out five or ten per cent or more on one day than on another. Yet this is just the kind of thing every merchant is doing today. For though his yardstick may not change, the value, the purchasing power of the dollars he receives in exchange for every yard of his merchandise is subject, from year to year, to just such uncontrolled variations, and the effect on him, as regards his profit per yard, is exactly the same as if his yardstick varied while the dollar remained constant, as a well-behaved dollar should.

Here, then, is the diagnosis: Wanted, a stable dollar; an unvarying yardstick, as it were.

For the remedy several suggestions have been made. The most obvious expedient, perhaps, would be to demonetize gold, and have the state issue inconvertible paper money in definitely controlled amounts. History shows, however, that this procedure leads to disaster, owing to lack of confidence in the paper issues.

A more promising plan is that which has been developed and advocated chiefly by Prof. Irving Fisher of Yale University. According to this plan the dollar, instead of being defined by a constant quantity of gold, whose purchasing power is subject to change, would be defined by a varying quantity of gold whose purchasing power were fixed.

This involves the determination of the purchasing power of gold, or, what amounts to the same thing, a so-called index of the general price-level. Such a determination is made by comparing for the two epochs under consideration, the weighted averages of the prices of some 50 or 100 or more of the most important commodities. The result varies slightly according to the particular method of averaging selected, but the variations among several of the best methods are inconsiderable, and one or the other of these will serve about equally well.

Such a scheme as Professor Fisher's, striking, as it does, to the very root of our monetary system, has naturally led to much discussion, though it has been very favorably received by most of the leading economists.

The plan is not, of course, presented, as a panacea for all economic ills, but only as a safeguard against those troubles which arise out of purely monetary conditions. Changes in general price level due purely to a change in the volume of money in circulation cause uncertainties and losses in long-term contracts or loans of any form, including the informal understanding between employer and the employee who receives a fixed salary of so many dollars a year. The contract or understanding is entered upon when the dollar has a certain purchasing power, say 100 per cent, but payment is made in whole or in part at some subsequent date, when the purchasing power is, say, 60 per cent. Evidently the person receiving payment is the loser, and the person paying is the gainer, without any compensatory service having been rendered.

(*Continued on page 145*)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Clouds Formed by Airplanes

To the Editor of the SCIENTIFIC AMERICAN:

The letter by Capt. Ward F. Wells, 60th Infantry, A. E. F., in your issue of June 7th, 1919, on "Clouds Formed by Airplanes" is a beautiful description; but his interpretation of what he saw is more than open to question.

Several times I have seen a ribbon-like trail in the sky behind an American pursuit plane. On one occasion I noticed that my motor, a Hispano-Suiza French-made, was giving out a trail of whitish-blue smoke which hung for some time in the perfectly still air. It was probably due to excessive oil feed as in the case of automobiles. I made large sweeping S's in the air and described one complete circle which I was informed hung there for some time.

Perhaps meteorologists have also written expressing doubt that the agitation of an airplane propeller in the air would be enough to create clouds.

DAVID W. HOWE,
Formerly 1st Lieut., 13th Aero Squadron, A. E. F.
Syracuse, N. Y.

The Drunkard's Farewell

To the Editor of the SCIENTIFIC AMERICAN:

Here enclosed is a copy of a verse entitled "The Drunkard's Farewell," which I came across in the SCIENTIFIC AMERICAN for October 3d, 1846, on Page 10 (Vol. 2, No. 1). It seems to me the verse is rather appropriate for today even though published 73 years ago.

Farewell drink, so nigh and handy,
Farewell rum, and gin, and brandy,
Farewell huts that see all weathers,
Farewell beds that have no feathers,
Farewell ways that I've forsaken,
Farewell tubs that have no bacon,
Farewell empty pots and kettles,
Farewell cupboards without "Vittals,"
Farewell faces red as crimson,
Farewell hats that have no rims on,
Farewell coat, more holes than stitches,
Farewell ragged vest and breeches,
Farewell broken chairs and tables,
Farewell dwellings worse than stables,
Farewell drunken song and carol,
Farewell friends who love the barrel,
Farewell drinking lads and lasses,
Farewell windows without glasses,
Farewell floors that need a swab-file,
Farewell yards that have no wood-pile,
Farewell bonds that I have broken,
Farewell oaths that I have spoken,
Farewell landlords and bar tenders,
Farewell all blue-devil senders.

CHARLES L. HARVARD.
Chicago, Ill.

Poison Gas or Cootie Machine?

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of June 21st an instance is given of the effects of poison gases on leather.

If it was the result of a laboratory test I would not have any objections, but it seems to me that the overcoat in question was put through a delousing machine before the N. C. O. removed the gloves from its pocket. In that case your advice would have to be amended.

I have seen many cases of that kind in France and never heard of any being charged to German gases.

CPL. J. G. WHITE.
Camp Merritt.

That Langley Manley Engine—The Last Word

To the Editor of the SCIENTIFIC AMERICAN:

I note in your issue of June 14th a criticism on a previous comment made by the writer regarding the Langley-Manley engine of 1901. As soon as I discovered that I was in error in supposing this to have been a steam motor, I made suitable apologies both to the editor of the SCIENTIFIC AMERICAN and to Mr. Griffith, of the Advisory Committee of Aeronautics. I was not aware at the time of making the criticism that a light gasoline motor had been built for a Langley machine.

Before replying to Mr. Bell's criticism, I wish to say that the great mechanical progress of the world in the past century and a half has in my opinion been due to two discoveries (namely, the discovery of oxygen and the discovery of electricity) and one invention (namely, that of the steam engine).

I wish to state further regarding the criticism of Mr. Bell that I still maintain my opinion regarding the unsuitability of steam engines for airplane use.

I note that Mr. Bell uses a capital letter in speaking of the "Rocket," evidently supposing that I meant the famous locomotive constructed by Stevenson nearly 100 years ago, while my reference was merely to an ordinary rocket such as are used on the Fourth of July, or other occasions, and which are actuated by gunpowder or other explosive.

I am not undertaking to defend the gas engine. It seems to be able to defend itself in its own sphere.

I notice lately that two of them have recently succeeded in crossing the ocean through the air on their own power.

If there are any steam plants navigating the atmosphere at the present time I have failed to notice them flying about.

ELWOOD HAYNES.
Kokomo, Ind.

The House Fly Takes Hold

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of June 28th, I carefully read the article under this title, but was somewhat disappointed that it did not mention the muscular action of the part containing the pseudo-trachea and branches.

I have closely observed the fly under a compound microscope and had the rare opportunity of having a fly light on the under side of the glass and use his proboscis vigorously, and I noticed that when the proboscis or rather the sucker of the proboscis, as I called it, was in natural action the branch trachea swept inwardly rhythmically. If the bifurcations of the branch trachea, as revealed by your more powerful microscope, point inwardly, to the oval opening, I can see a real use for them and why a continued rasping would leave a red mark and possibly smart. This rhythmic action enables the fly to gather together the food particles which by muscular movement or sucking he draws into his pharynx.

BENJ. G. HESS.
Camp Funston, Kan.

Our Technical Achievement in the Great War—II

Training a Citizen Army of 2,000,000 Men Intensively in Nine Months' Time

As a rule, the average American soldier who went to France received six months of training before he sailed, and after he had been landed overseas there followed another two months of training either in England or in France. Then he was sent up to a part of the battle line that was in a quiet sector, and here he became accustomed to trench life and the varied experiences of the actual front. At the end of the month he was considered to be in shape for transfer to an active sector for participation in the hard fighting of the great battles.

It must be understood that individual soldiers, many thousands of them, will have a different story from this, to tell of their experiences; but a careful examination by the War Department of the training data of some 1,400,000 men, who actually fought in France, gives the actual average results shown above.

Our Soldiers Were Trained in Divisions

The infantry soldier was trained in our typical combat unit, the division, which in the American Army is composed of about 1,000 officers and 27,000 men. Outside of the Infantry divisions there were training and sorting organizations of about 10,000 men known as Depot Brigades; but the government policy was to put new recruits almost immediately into the divisions in which they would finally go into action. At the signing of the armistice, 42 divisions had been trained and sent overseas, the training of 12 others was well advanced, and four other divisions were being organized. It is strongly suggestive of what was facing the German army should the war have extended into the year 1919, to learn that the plans on which the Army was proceeding called for the placing of 80 divisions in France before July, 1919, and 100 divisions by the close of this year.

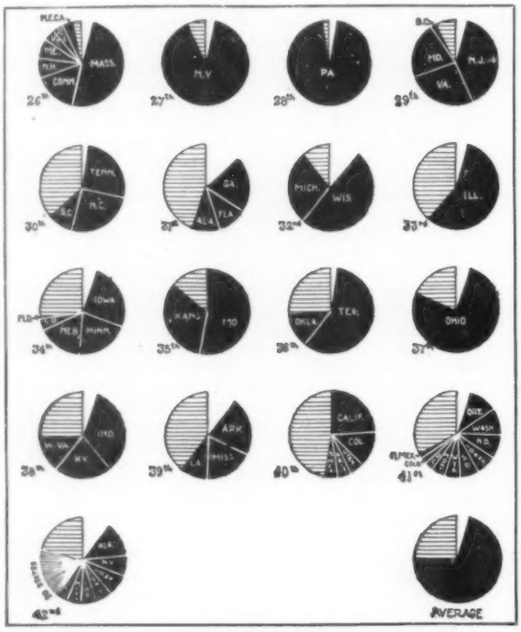
The divisions which were organized and trained before the signing of the Armistice were divided into three groups; the Regular Army divisions which were numbered from 1 to 20; National Guard Divisions, numbered from 26 to 42; and the National Army divisions, numbered from 76 to 92, which were made up almost entirely of men called in under the Selective Service Act.

Composition of National Guard Divisions

The make-up of the National Guard divisions is shown in the accompanying diagrams, in which the black portion of each circle shows the number in each division drawn from the National Guard; the shaded portion the troops drawn from the National Army and other sources, and the unfilled gap the number of troops that the division was short of its authorized strength when it sailed. The average composition of the National Guard divisions was about two-thirds State troops and one-third other troops. The diagrams show clearly how the 42d Division, which was made up of selected groups from over the entire country and sent to France early, by its composite character, came to be called the "Rainbow Division." The 41st Division, which was a composite of troops from many Western States, bore the appropriate name of "Sunset Division."

The Camps and Cantonments

One of the greatest feats of construction in our preparations for war was the rapid provision of shelter for 1,800,000 men during their period of training. For the National Guard and National Army divisions, 16 camps and 16 cantonments were built. The National Guard units being organized rapidly during the summer of 1917, were put under canvas throughout the South, and the cantonments, which were built largely in the North, were for the National Army, which was called in the autumn of 1917. Troops had to be accommodated at many other points besides the 32 camps and cantonments. There were schools for training men for special services, such as the Artillery, Aviation, Engineering Corps, Chemical Warfare, Tank Corps and Quartermasters Corps. There were also proving grounds and testing fields, such as the great Aberdeen Proving Ground, a description of which was given early in the year in the SCIENTIFIC AMERICAN. For these purposes additional housing had to be constructed with a capacity for over 300,000 men.



These diagrams show composition of National Guard Divisions

Location of the 32 camps and cantonments

Rank	Number commissioned	Per cent
Colonels	2	
Lieutenant Colonels	1	
Majors	294	1.4
Captains	5,429	6.7
First Lieutenants	12,397	15.4
Second Lieutenants	62,445	77.5
Total	80,568	

Officers commissioned from training camps by ranks

Branch of Service	Number commissioned	Per cent
Infantry	48,968	60.7
Field Artillery	20,291	25.2
Quartermaster	3,067	3.8
Coast Artillery	2,063	2.6
Cavalry	2,032	2.5
Engineer	1,966	2.4
Signal	1,262	1.6
Ordnance	767	1.0
Statistical	152	.2
Total	80,568	

Officers commissioned from training camps by services

Instructors for Training 4,000,000 Men

In the American Army there is one officer for each 20 men. Consequently for an army of 4,000,000 men not less than 200,000 officers were required. Over against this set the fact that, when war was declared, there were only 6,000 officers in the Regular Army, and the magnitude of the officer problem will be understood. Fortunately, the National Guard divisions were able to furnish their own officers, but when this supply was exhausted it was still necessary to secure 180,000 officers elsewhere.

Thanks to the initiative of General Leonard Wood long before we entered the war, it was found that the Officers' Training Camps, which were operated on the lines of the Plattsburgh camps, were equal to the problem of securing the 180,000 officers for the American Army. Candidates, after passing rigid physical and mental tests, passed through three months of intensive training, in which they were put through all the tasks required of the enlisted men and the duties of the platoon and company commander. The largest number of graduates, 62,445 in all, were made Second Lieutenants; but exceptional ability, coupled with previous military training, brought, in some cases, more advanced commissions. The diagrams published herewith show the number of officers commissioned by ranks and also by services. It will be seen that the Infantry absorbed over sixty per cent and the artillery 25 per cent of the officers.

French and British Instructors

When the United States declared war, the French and British had already been fighting the enemy for over two and one-half years, and therefore had gained a large amount of experience in the methods of fighting developed during the war. Consequently, soon after the new camps were formed, France and England sent to the United States some of their ablest officers, who had seen service on the Western front, in order that they might bring into the training of our new armies the latest methods developed during the war. We publish two diagrams showing how the subjects of training were divided between the members of the French and British groups. In addition to these officers, the British also detailed 226 non-commissioned officers as instructors. They were assigned to different subjects in about the same ratio as the officers. The War Department states that these groups of foreign instructors attached to training schools, divisions and other units, "rendered services out of all proportion to their number. They were a significant contribution to our training program."

Total Time of Training

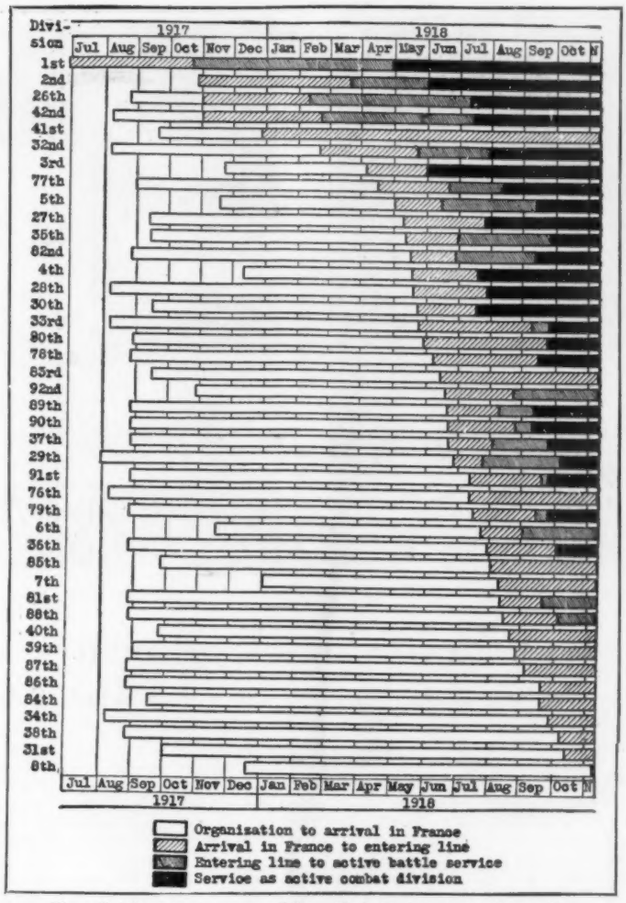
As a rule the average division had been organized eight months before sailing for France and it received two months of training between the time of landing and the time it entered the front line. The accompanying table shows these periods for each of our 42 divisions. Each division is represented by a horizontal bar, divided into two or more sections. The white portion shows the period from the date of organization to the date of arrival of its headquarters in France. The lightly-shaded portion, represents the time in France before the division entered the line. The heavily-shaded portion indicates the time between the division's entering the line for the first time and its engaging in combat in an active sector. The solid-black portion represents the length of service as an active combat division.

The First and Second divisions left this country as separate units, and were organized as divisions in France. The troops were composed mostly of thoroughly trained men of the Regular Army, and the Second Division also included two regiments of Marines. The next three divisions in the list were composed of selected units of the National Guard, most of which had seen service on the Border, and could be relied upon as well-trained bodies of troops. The rest of the divisions show extended periods of training in the United States. The Regular Army Divisions, as was expected, show the

shortest periods of training in this country, since they were made up of the most experienced soldiers.

The great German drives were in full swing in June, and the Allies called upon us to continue the extraordinary transportation of troops begun in April, The early movement had been met by filling up the divisions that sailed with the best-trained men wherever they could be found. By November the average period of training in the United States had been reduced to about four months and the average from July 1st to November 11th was about five months.

In the last months of the war, the induction of men into the service was carried forward at topmost speed and every possible device was used to hasten the training. "The result," says Colonel Leonard P. Ayers, "fully justified the effort. Into the great Meuse-Argonne offensive we were able to throw a force of 1,200,000 men, while we had many thousands of troops engaged in other parts of the line. Our training-camp officers stood up to the test; our men, with their intensive drilling in the open-order fighting, which has characterized American training, routed the best of the German divisions from the Argonne Forest and the valley of the Meuse."



How divisions were engaged from their first organization to the close of the war

Mica

PHLOGOPITE, or amber mica, is soft and pliable, and is well adapted for certain electrical purposes, though its dielectric strength is not as great as that of high-grade muscovite. While it is widely known and in fair demand, the only commercial deposits so far discovered are confined to the Provinces of Ontario and Quebec, not far from the city of Ottawa.

One of the important deposits is near Kirk's Ferry on the Gatineau River about 12 miles north of Ottawa. The deposit was first worked as a phosphate mine, and later for its mica content. It consists of a series of parallel veins in gneiss, the phlogopite being associated with pink calcite, pyroxene, and apatite. The workings are for the most part superficial, and no definite plan of development has yet been worked out. On account of a dull market, production is lagging. Present activities are confined to recovery of mica from the dump piles accumulated in early days when the deposit was worked for phosphate only. There is evidently a large reserve of mica in this locality. What is probably the largest and best developed mica mine on the American continent is located near the town of Sydenham, in northwestern Ontario. The deposit consists of irregular pockets and well-defined veins in granite gneiss. The mine was first operated as an open pit worked to a depth of over 150 feet. Later, shafts were sunk and drifts projected at various levels, the lowest being 100 feet below the surface. Two types of mica are obtained, dark amber and pale amber known as "milky," the former being of superior quality.

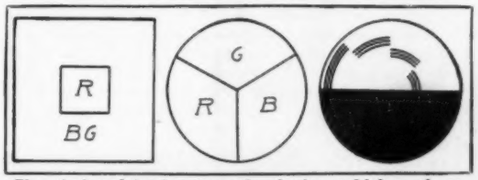
Many other deposits of amber mica are worked, for the most part spasmodically. It is evident that the Canadian deposits are ample to supply all prospective needs, and that amber mica mining will continue indefinitely.

Some Interesting Color Phenomena

By M. Luckiesh

THERE are many interesting color phenomena which either are unknown outside of purely scientific circles or have not been observed under striking conditions. Many of these might well be termed "color illusions" in the same sense that a vast array of geometrical arrangements of lines and areas are termed "optical illusions." It is the aim of this article to describe briefly a number of color phenomena which may be readily observed and reproduced. Most of these phenomena are to be seen about us in Nature, in painting, in decoration, etc., but ofttimes they are witnessed most strikingly by the use of colored media or colored lights in special, though usually simple, apparatus. In the diagrams accompanying this article the initial letters of the spectral colors indicate these colors respectively.

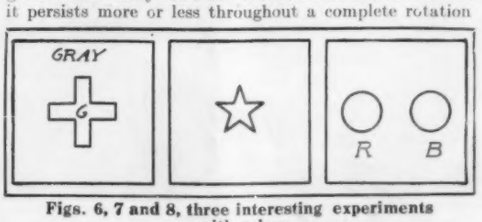
If a bright red paper two inches square (Fig. 1.) be pasted on a blue-green cardboard about six inches square and this be moved at arm's length in a dim light while the eyes are fixed on a point in space through which the cardboard passes during the arm movement, the red square will appear to lag and, therefore, to shake as though it were a piece of jelly. When the intensity of illumination and the movement of the arm are correct the effect is very striking. The red square appears to lag or to stretch out behind its true position, and when in this apparently stretched condition, it appears somewhat changed in color. Perhaps chromatic aberration of the eye may have some part, but doubtless the different rates of growth and decay of the two color sensations chiefly account for the phenomenon.



Figs. 1, 2 and 3, showing color devices which produce interesting illusions

If a disk composed of three sectors, namely, red, green, and blue (Fig. 2.) be started to rotate it will finally reach a speed when the green is seen to persist on a flickering background. Green sensation is more sluggish in its growth and decay than the red and blue sensations and it persists more or less throughout a complete rotation at a speed too low for the red and blue to persist. Hence at this speed the disk appears green upon which there is still a flicker due to the red and blue. A phenomenon of the same catagory can be produced with black arcs on a white ground as indicated in Fig. 3. When rotated slowly colored circles are visible in the radial positions of the black arcs. The colors of the circles differ considerably from the smallest to the largest in a definite order. If the direction of rotation is reversed the colors of the circles are reversed. The effect of the different rates of growth and decay of color sensations can be demonstrated by means of disks of various arrangements. If the black and white of Fig. 3 be replaced by colors, some very striking effects are produced.

Figs. 4 and 5, devices for producing illusions of distance and for detecting chromatic aberration



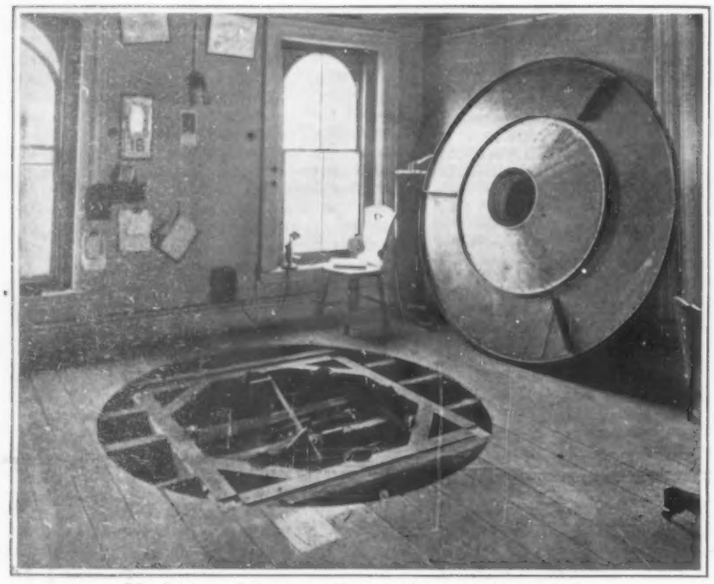
Figs. 6, 7 and 8, three interesting experiments with colors

The artist speaks of "retiring" and "advancing" colors and attributes these peculiarities to the "cold" and "warm" colors, respectively. That is, when such colors as violet or blue are viewed simultaneously and actually in the same plane with orange or red, the former appear at a greater distance than the latter. This is sometimes strikingly illustrated in lantern-slide advertisements projected upon a screen. For example, a group of red letters on the screen ordinarily will appear nearer the observer than a group of blue letters. This is demonstrated in a better manner by means of two boxes each containing a lamp which illuminates a red diaphragm in one box and a blue one in the other as indicated in Fig. 4. If these are placed in a dark room the two diaphragms stand out in a dark void. A letter "E" cut out of cardboard and covered with red glass is a satisfactory character to compare with another letter such as "X" which is covered with a blue filter. The use of different characters eliminates or at least greatly reduces the influence of size of character (if they are alike) upon the judgment of distance. By moving one box nearer or farther away from the observer it is possible to obtain a measure of this phenomena for the colors used. In general, the blue character must be moved considerably nearer the observer than the red one in order that the two *appear* equidistant. By such an experiment it is found that to most observers the blue is "retiring" and the red is "advancing." However, to some observers the phenomenon does not appear to exist and to others it actually reverses. It appears possible to explain the matter on the basis of chromatic aberration of the eye. Owing to this refractive error the retinal red images are not spadially coincident with the retinal blue images, and, inasmuch as the judgment of distance under such conditions depends largely upon the disposition of the retinal images for binocular vision, it is not surprising that two different colors in the same plane should appear at different distances. The phenomenon does not appear to exist for monocular vision. Differences among various observers may be explained by differences in radii of curvature, etc., of the eye media. If pinhole diaphragms are placed before the eyes and moved laterally nearer each other or farther apart, the phenomenon is usually very much more striking.

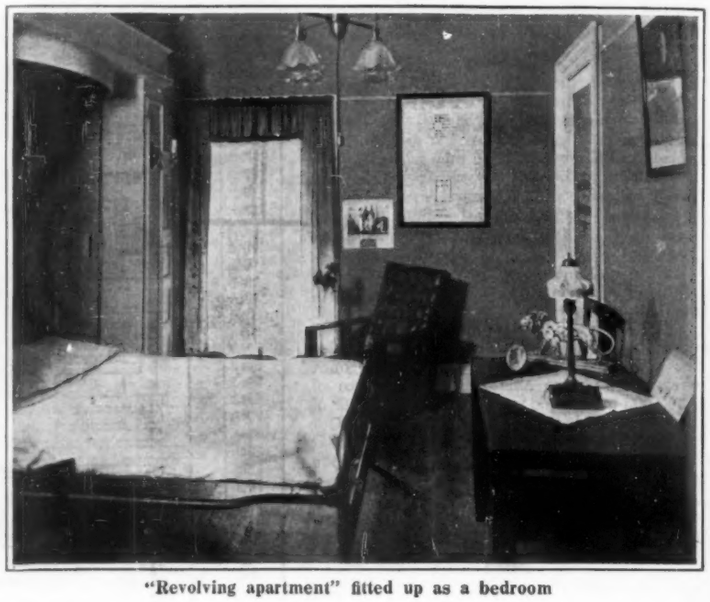
The chromatic aberration of the eye can be demonstrated in many ways. If a line spectrum such as that of the mercury arc be focused on a ground glass of a spectrograph it will be seen that the blue lines can be seen distinctly very much closer than red lines, and, conversely, at a normal distance (14 inches) the red lines are seen distinctly, but at the same time the blue lines are blurred and indefinite in outline. In fact, the violet and blue rays ordinarily cannot be brought to a focus on the retina at the latter and greater distances. Inasmuch as the eye is not achromatic the blue rays come to a focus at a point ahead of the point at which the red rays focus. In ordinary vision in white light the sensibility of the eye is so much greater for the rays of the middle of the spectrum that the diffusion rings due to blue and to red rays which are out of focus are not ordinarily distinguished. If a series of concentric black circles on a white ground as in Fig. 5 be viewed close to the eye colored fringes are seen. These are the result of chromatic aberration, but an explanation is too involved to be presented here. On viewing the rings close to the eye it is interesting to note the distortion of the circles. Another way to demonstrate this eye defect is to view an incandescent lamp filament through a purple filter; that is, a filter which transmits only the extreme violet and the extreme red rays. Some dense cobalt glasses are satisfactory.

Among the dyes, methyl violet is satisfactory as a filter for this purpose. When the lamp filament is

(Continued on page 146)



Mechanism of the turntable on which the cabinet revolves



"Revolving apartment" fitted up as a bedroom

A Revolving Apartment

Making One Room Take the Place of a Whole Suite

THE scarcity of houses this year has set inventors to thinking. There is a tendency in large cities toward small apartments. It seems as if the larger the city, the smaller its apartments, because of the high cost of real estate and the high taxes. New York is notorious for its small apartments. The space which would make a single room of fair size in an old-fashioned house is divided by partitions into parlor, dining room, kitchen and bath, with one or more bedrooms. Small wonder that special apartment furniture is made to fit the tiny rooms. The stores are filled with compact combination pieces that can serve a variety of purposes, and are designed to occupy a minimum of precious space. Such conditions have endured for years, but in these days, when the demand for living quarters is greater than ever, the attention of the public has been directed to the fearfully cramped housing conditions of our big cities.

One inventor has hit upon a very original scheme. We have our combination furniture in which a couch will serve as a billard table, and a book case as a bed, etc., but we have not heretofore thought of making a combination room. Why should a man who cannot afford to rent a space more than fifteen or twenty feet square, have that little space chopped up into half a dozen tiny rooms? A large family may need several rooms, but why should a single occupant, or a childless couple have one room to sleep in, another to eat in, another to cook in, and still another in which to receive guests? Why not leave out all the partitions and have one decent-sized big room that will serve all these purposes? A single occupant certainly cannot use more than one room at a time. Why not convert his one room into parlor or kitchen as the case may be? The inventor has answered this question by building what he calls a "revolving apartment." It is true the apartment does not revolve, but the elements which change the room for the various purposes to which it is to be used do revolve. They are in the form of a cabinet mounted on a turntable and arranged something like a revolving bookcase. There are four sections to this cabinet in one of which there is a folding bed; alongside the folding bed there is a dresser; a kitchenette occupies another compartment, and finally there is a bookcase and writing desk. By revolving this cabinet so that the various compartments come into service, the same room can be used for sleeping, dressing, eating and "living," to use the term commonly applied to such a room.

As shown in the upper left-hand illustration, a large circular opening is cut in the floor near one corner of the room. In this is mounted a frame bearing grooved rollers. On this frame is the base of the turntable which has a track engaging the rollers, so that it may be revolved readily. A partition cuts off the room just in front of the revolving cabinet, and a door in the partition at one side of the cabinet opens into a bathroom. The picture on the right at the top of the page shows the room fitted up as a bedroom. The folding bed has been turned down out of the cabinet, into the room. When the occupant rises in the morning, he folds up the bed in the cabinet, giving the latter a partial turn so as to bring the dresser into view, as shown in another of the illustrations. After he has completed his toilet, another turn of the cabinet brings the kitchenette into service. This is a very complete outfit, with an electric stove and a sink. Down below there is an ice box and there are plenty of drawers in which table utensils and kitchen utensils may be kept. At one side there is an ironing board which may be turned down into service position if desired. Up through the center of the cabinet there is a pipe which serves not only to steady the cabinet as it revolves, but also to carry off smoke and fumes from the kitchenette. Running water is supplied to the sink through a pipe which has a swivel connection that passes down through the center of the turntable.

After the bed is folded up the dresser is swung into position for service

The apartment converted into a dining room and kitchenette

As the kitchenette is placed in the wall of the room, the rest of the room can serve for dining purposes. A table which is ordinarily used as a library table is provided with a leaf which way be drawn out for dining purposes, but if there are guests the entire table may be cleared off and used as a dining room table. Having done with breakfast the cabinet is given another turn, bringing into view the book case and writing desk, thus converting the compartment into a living room or library.

While this plan is exceedingly novel and very ingenious, we fear that the unscrupulous landlord will make use of it to reduce still further the size of living quarters. He will see no reason for having a large main room, but will use small rooms, making more apartments to the floor, as long as he can place in each a revolving cabinet that will furnish all the needs of an ordinary multiple-room apartment.

Salvaging Ships with Canvas Bags

RAISING a sunken vessel by pumping air into the hold is not a new process. Many vessels have been raised in that manner in recent years. If the deck is strong enough and the wound which the vessel has sustained is low enough the hatches may be closed and the air pumped into the hold. This expels the water through the break in the hull and when the vessel has been lightened sufficiently it rises.

While this sounds very simple the problem is complicated by a great many important details. It is not often that the deck of the ship will stand the strain. Decks are built to bear a downward pressure; they carry the load on the upper surface. When this condition is reversed and air pressure is introduced underneath, the deck is liable to be torn loose. In some cases the deck may be strengthened so that it will support this load without leakage of air. The air must be kept from collecting at one end of the vessel, otherwise the bow or stern might come up leaving the rest submerged. Usually the vessel has to be divided into compartments, and sufficient air introduced into the various compartments to bring it up on an even keel. This calls for a great deal of work on the part of the divers, which adds to the cost of salvage and in some cases makes it absolutely prohibitive. When the vessel is in an exposed placed storms are liable to interrupt the work at any moment, and operations that have consumed weeks may be destroyed inside of an hour.

In order to obviate under-water work as far as possible a new plan has been introduced of using canvas bags to confine the air in the hold of the vessel. The accompanying photograph shows a set of these canvas bags, three of which are inflated and give some idea of their size. The bags are about 10 feet in diameter. They can be introduced into the hold in collapsed condition, and arranged under such portions of the deck as may be able to stand the upward strain. It is not necessary to repair any wounds in the vessel and the bags can be used even when the hull is broken near the main deck. After a sufficient number of bags have been introduced air is pumped into them and by varying the amount of air in the various bags, the vessel may be brought up evenly, after which it can be towed to a drydock and be repaired.

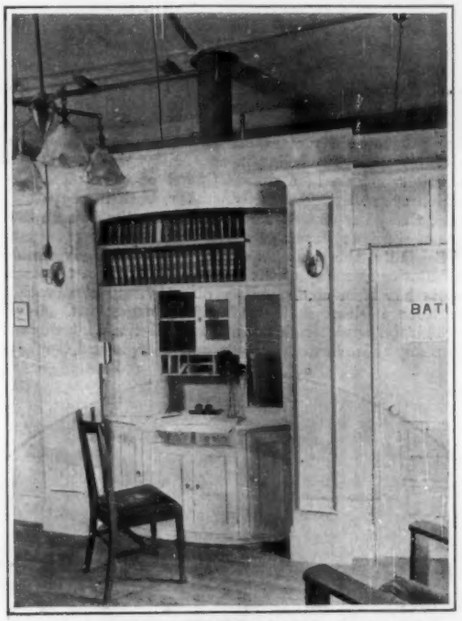
Canvas airbags used for salvaging sunken vessels

Enter Truck, Exit Mule in Bolivia

"INTRODUCED in Bolivia only a few years ago, the American motor truck is rapidly making good," said the representative of a large mining company. "It is needed mostly to haul ores from the mines to the railways. The roads in the mining districts are narrow and rough and in some places do not permit the passage of wagons or carts. On the plateaus, however, the going is better and the use of the motor truck has resulted in speeding up the transportation of tin, tungsten and other minerals to points of shipment. The Government is improving the roads in many parts of the country, which is resulting in larger purchases of passenger automobiles from the United States. Only two were imported in 1913, but last year 141 cars were brought in. In 1917 twenty motor trucks were imported from the United States, and there are probably not more than thirty such vehicles in Bolivia at present. My company bought two recently and will place orders for more when conditions permit shipment."

During a recent visit to the United States the owner of several Bolivian tin mines arranged for the construction and purchase of a number of motor trucks to be used in transporting tin and concentrates from his mills to the nearest railway station, a distance of about sixty miles. The roads, with an average grade of nearly five per cent and a maximum of nearly fifteen per cent, are good for about nine months in the year, but in the rainy season the constant traffic makes them almost impassable. With the roads in good condition it takes six mules to draw a cart containing four tons of ore, and six more are needed on the heavy grades. During the wet season only two tons of ore can be conveyed in a single cart, and 12 extra mules are required where the hills are steepest The ore must reach the point of shipment within a given time.

The first American motor trucks that have been placed in service of this sort have made a haul for the Bolivian mine owner that will result in another kind of haul for the American manufacturer. An official of an American automobile company was asked whether his trucks negotiated a 15 per cent grade. "They went over the top of a 22 per cent grade in New Zealand," he replied, "And I am sure that they can give a good account of themselves in Bolivia."



The book case and writing desk convert the apartment into a living room

The Deepest Wells in the World

THE Hope Natural Gas Company, of Pittsburgh, enjoys the reputation of having twice broken the world's record for deep wells within the past two years. One of these deep borings, known as Martha Goff well No. 4190, is located eight miles northeast of Clarksburg, W. Va. Drilling was begun April 19th, 1916, and on March 4th, 1918, a depth of 7,386 feet had been reached, thus exceeding by 37 feet the depth of the well hitherto known as "the deepest well in the world," located at Czuchow, Upper Silesia, Germany. At this depth the steel cable parted, over 5,000 feet down, leaving the tools and 2,000 feet of cable in the hole, and the well had to be abandoned. This record has since been surpassed in the I. H. Lake well No. 4304, drilled by the same company 6½ miles southeast of Fairmont, W. Va. Drilling began here August 5th, 1916. On June 18th, 1919, a depth of 7,579 feet had been reached; 193 feet greater than the depth of the Goff well. At this depth misfortune again overtook the company. The tools stuck in the drill-hole and the cable parted, leaving tools and 4,000 feet of cable in the hole. "Fishing" was unsuccessful, and this well, also, has been abandoned. These wells were sunk in the hope of reaching the rich gas-bearing and oil-bearing "Clinton" (Medina) sand, which extends across eastern Ohio and is supposed to underlie the part of West Virginia in question. The failure to reach the petroliferous bed was due to an unexpected thickening of the Devonian shales, one of the overlying series. In the case of the Goff well, interesting fossils and other geological material were secured, and a valuable series of temperature measurements was made. According to C. E. Van Orstrand, of the U. S. Geological Survey, the temperature at 7,000 feet was found to be 172 degrees F., and the rate of increase at that depth was one degree in 51 feet. It is estimated that the boiling point would be reached at about 10,000 feet below the surface.

Keep Distributor Clean and Dry

EXCESSIVE oiling of a magneto can do nearly as much harm as insufficient lubrication. One thing it does is to cause the surpuls oil to be thrown into the distributor, where it works all kinds of mischief. It gets between the brush and the contacts and either insulates them from each other entirely, causing missing, or it causes arcing. Arcing in turn burns the oil and forms soot which soon gums things up badly and it also produces heat which disintegrates the carbon brush and causes it to crumble in time.

All magneto manufacturers make their distributors so that they may be removed easily and wiped clean with a dry, clean cloth. One magneto, for instance, has the distributor held on by three little clips, retained by three thumb nuts. These may be loosened by hand, the clips turned aside and the distributor cover comes off in the hand. Other magnetos have three screws to retain the cover. Some have a central revolving brush and stationary contacts in the cover and others a revolving contact and individual stationary contacts in the cover. The brushes in either case are attached to small springs and may be slipped into or out of their sockets by hand.

Aluminum Leaf to Moisture-Proof Wood

AVERY effective agent for moisture-proofing wood has been found in an aluminum leaf coating. This coating practically insulates the wood against any change in atmospheric conditions, and is particularly valuable for use where accurate form and balance must be maintained, as would be necessary in an airplane propeller.

New Way of Shipping Lumber at New Orleans

ON account of the current of the Mississippi River and its wide variation of depth at different seasons, it has heretofore been thought that cargo shipments could not be profitably made out of New Orleans, but a new method of handling export pine shipments by loading directly from the water, has been developed. In the upper part of the city a prominent lumber and export company has begun the installation of extensive and modern facilities for handling cargoes of lumber and timber. These include a timber boom extending 1,800 feet along the river front and 600 feet out into the water. This boom will be enclosed by floating timbers which will rise and fall with the water and will be held in place between double rows of clusters of piling at proper intervals to hold them securely in place. Gates at either end will permit ships to pass in and out, and the boom extends far enough into the river to assure ample depth to handle timber at any stage of the water and permit space for several vessels to load in the boom at once.

There will be a huge wharf to provide for the quick and economical dumping of the timbers into the boom and a large storage yard on the shore back of the wharf will store great quantities of lumber. Besides economy in handling, an almost unlimited storage capacity is afforded and a great surplus of export stock can be kept on hand so that orders may be filled without delay.

It is felt that the growing importance of the export trade in the western portion of the southern pine regions makes New Orleans more than ever the logical shipping port and for this reason these exceptional facilities have been established.

The Heavens in August 1919

The Mysteries of the Milky Way

By Prof. Henry Norris Russell, Ph. D.

IN our last article we spoke of the results of recent investigations upon the distances of the remoter stars of the Milky Way, and told why we have reason to believe that our soundings of the depths of space have at last begun to strike bottom, finding that the depth of the Milky Way in the northern sky—say in Aurega or Perseus—is something like twenty or fifty thousand light years. While on the opposite side of the heavens, in Sagittarius it is probably at least three times as great.

Whether we have actually "struck bottom"—that is, reached the remotest of the stars by our methods of investigation—in this region we can not yet be sure; but there is good reason to believe that, in many places, we strike a false bottom.

One of the most conspicuous characteristics of the Milky Way is the irregular and patchy distribution of brightness within it, and the presence of many dark holes and pockets, especially in its brightest portions. A prominent example is found in Cygnus, where one of the brightest regions of the northern Milky Way is crossed by a wide dark lane, which to the naked eye seems so sharply defined as to suggest at a glance that the sky is obscured by a strip of cloud. Another and even more notable dark region is found near the Southern Cross, and looks so black that it has been known to navigators for a century as the "Coal-Sack." Other intricate dark lanes may be seen, even with the unaided eye, among the great clouds of the Sagittarius region.

But the full extent, and extraordinary character of these dark markings in the Milky Way is revealed only by photography. The pioneer in this field was Barnard, who, at the beginning of his work at the Lick Observatory, systematically photographed the Milky Way with a small lens (taken from a magic lantern!) which gave negatives covering a large field, and so revealing many things which were too big to be detected in the small fields of view of other and otherwise more powerful instruments. Later photographs with larger instruments, also of wide field confirmed these discoveries, and showed that the skies are full of dark markings. In a recent paper, Professor Barnard gives a catalogue of 182 such objects, and adds that this list is by no means complete.

Some of these dark markings are large, and rather ill-defined; but many of them are small and exceedingly definite in outline. For example, in one of the brightest regions in Sagittarius there is found a small spot (in R. A. 17 h. 55 m. declination −28°) which is only five minutes of arc in diameter, but so black that even with a small telescope, it looks "like a drop of black ink on the bright background of the Milky Way." Other markings are long, narrow and crooked, but nevertheless sharply and definitely bounded. No verbal description can do justice to their singular appearance, which can be appreciated only from the photographs themselves.

When but few of these objects were known—and those the large and less sharply defined in outline—it seemed reasonable to suppose that they were simply holes or gaps in the Milky Way, through which we saw the dark background of empty space beyond. But such markings as have just been described are hardly explicable in this way. Small black spots, surrounded by the brightest parts of the star-clouds and with sharp edges, would mean that the cloud was pierced by narrow openings or tunnels almost circular and uniform in cross-section and directed exactly toward the point in space at which the Earth happens to be situated; and the narrow winding dark lanes would demand even more extraordinary openings in the star-clouds for their explanation.

To these difficulties may be added another (suggested by Professor Campbell). We know that the stars in general are not at rest, but in motion. If such a hole in the star-clouds should actually exist, at a given time, many of the neighboring stars which were moving towards it, would soon move into it, and it would be filled full of stars again within a few hundred thousand years—which, though a long time, historically speaking, is a very short time indeed from the geological or astronomical standpoint. Hence, if these dark markings are actually holes in the Milky Way, we must suppose that they are of recent formation—which passes all belief.

But if these dark spots are not holes in the star-clouds what are they? The only possible answer appears to be that they are actual dark clouds of matter between us and the Milky Way, "*dark nebulae*" which hide whatever lies behind them.

Startling as this view appears at first sight, the evidence in its favor seems to be convincing. In the first place, the shapes of many of these dark objects are very similar to those of known bright nebulae. Barnard has published a remarkable pair of photographs—one showing a dark marking in the Milky Way, the other a bright nebula in a different part of the heavens—which are so extraordinarily similar, both in shape and size, that they suggest irresistibly that the two objects are of similar nature.

Secondly, the existence of faint, but definitely visible nebulosity in many of the most noteworthy of the dark spots has been confirmed by direct visual observation with large telescopes under favorable conditions.

Thirdly, some of the greatest of all the dark regions (notably those in the constellations Scorpio and Ophiuchus) grade imperceptibly into extensive and well-known nebulae. What is more, the spectrum of the most noteworthy of these nebulae, which surrounds the star Rho Ophiuchi, resembles that of the star, and indicates that it shows by reflected light.

There is therefore the best of reason to believe that there exist in interstellar space great clouds of sparsely diffused matter—occasionally rendered faintly visible by the light of some star which is immersed in the cosmic fog, or again carrying with it rarefied gas, which shines by its own light—but usually non-luminous, and making its presence known only by obscuring whatever luminous bodies may lie behind it.

The dimensions of these dark nebulae are exceedingly great. The one previously mentioned which surrounds several stars in Scorpio and Ophiuchus, must be at substantially the same distance as these stars—that is, from 300 to 500 light years away from us. The central mass of this region of obscuration is 3½ degrees in diameter, which means that its real diameter must be at least 20 light years, and from it great "dark lanes" run eastward for fully 10 degrees, which must represent cloudy regions or space, fully 70 light years in length, and some five light years in width. No other known objects except the globular clusters, and probably the spiral nebulae, can compare at all with these in vastness.

Of course, it is almost certain that, within these huge regions, the dark material is scattered with extreme thinness. Though they may be many light years in thickness, the whole quantity of matter which would be met by a ray of light which attempted in vain to traverse them need not be greater than that in a layer of ordinary terrestrial cloud a few yards in thickness—indeed much less, for by far the greatest part of the mass of matter contained within a cloud is that of the invisible air which buoys up the minute water drops that make the cloud visible to us.

We cannot, therefore, attempt to estimate, even roughly, what the amount of material in these huge clouds may be. But there can be little doubt that such clouds have an important part in making the starry heavens look to us as they do. We see them best when they are projected against the bright background of the Milky Way; but Barnard finds similar dark patches, here and there, in other parts of the sky, showing up dimly against a very faintly luminous background.

It is not improbable, though not yet proved, that the division of the Milky Way itself into two branches throughout a large part of its course is only apparent, and due to the interposition of a great layer of light-absorbing clouds of this sort. Shapley, in his studies of the globular clusters, has found that, although they increase in numbers as the plane of the Galaxy is approached, there is none at all to be seen close to the central line of the Milky Way. Are there really no globular clusters in this region, or are they hidden from us by intervening absorbing matter? In favor of the latter view are the facts that the great majority of the globular clusters lie in those regions of the heavens in which the Milky Way is split into two branches and that, as Charlier has shown, these clusters, though thickly sown in both the branches of the Milky Way, are absent from the dark zone which separates them. This suggests very strongly that the dark zone is really an effect of absorption; that the Milky Way—star-clouds, globular clusters and all—really extends an unbroken sweep across it, but that a great part of it, possibly the brightest portion of all, is hidden from us by enormous masses of absorbing matter.

It is here that we may well suspect that our celestial soundings have struck a false bottom. Whether these suspicions are founded on fact, the observations of the next few years will presumably show.

At 12 o'clock: Aug. 7.
At 11½ o'clock: Aug. 14.
At 11 o'clock: Aug. 22.

At 10 o'clock: Sept. 6.
At 9½ o'clock: Sept. 14.
At 9 o'clock: Sept. 21.

At 10¼ o'clock: Aug. 29.

The hours given are in "Summer Time"

NIGHT SKY: AUGUST AND SEPTEMBER

The Heavens

The region of the sky of which we have been speaking is now admirably exhibited in the south and southwest. Sagittarius and Scorpio are low on the horizon. Above them, through Ophiuchus and Aquila, stretch the two branches of the Galaxy, uniting beyond Cygnus, which lies overhead, and passing on to the single and far less brilliant stream in Cassiopeia and Perseus.

West of the Milky Way are found Lyra, high overhead, Hercules, Corona and Boötes in the west, and Draco and the two Bears in the north.

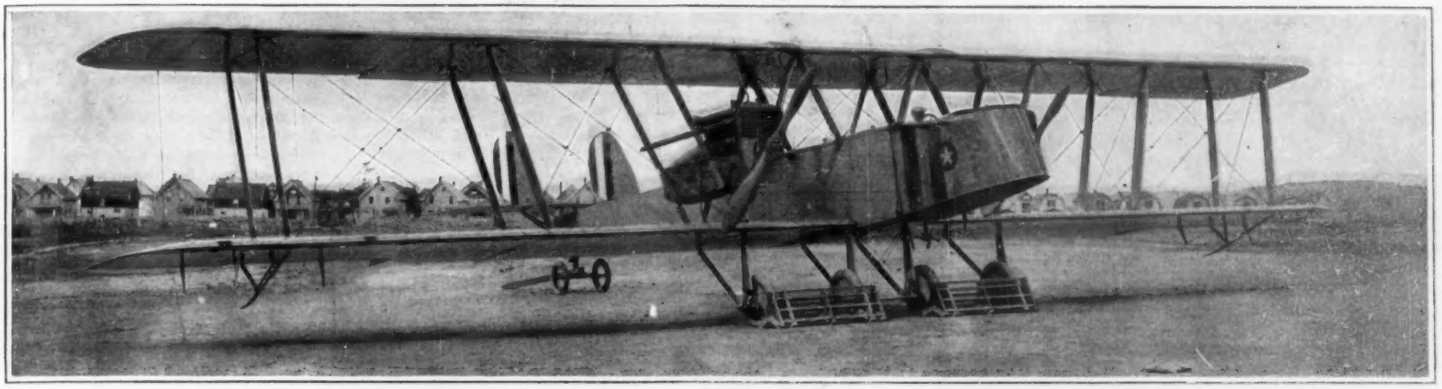
The eastern skies are poorer, the only really conspicuous objects being the great square of Pegasus in the east, and the isolated bright star Fomalhaut in the southeast.

The Planets

Mercury is an evening star at the beginning of the month, setting at 8.50 P. M. (by the present "Summer Time"). He draws rapidly in between us and the Sun, and is soon lost to view, passing through inferior conjunction on the 15th and becoming a morning star. By the end of the month he rises at 5 A. M. and is visible at daybreak.

Venus is an evening star, and at her greatest brilliancy early in the month when she sets about 9.30 P. M. Toward the end of the month she is much more nearly in line between us and the Sun, and on the 31st she remains visible only until 7.45 P. M. She appears tele-

(Continued on page 147)



The Martin Bomber—a type developed by us just prior to the signing of the armistice, and now being used for long-distance flights

Two Far-Reaching American Flights

SOMETHING of the nature of a real flight is now being undertaken by Lieut.-Col. R. S. Hartz, U. S. A., as well as by Capt. Roy N. Francis, U. S. A. Both fliers and their crews are using Martin bombers for their long-distance flights. Lieut.-Col. Hartz is making a flight about the rim of the United States, so to speak, involving something like 8,000 miles. Captain Francis, on the other hand, is to make a trans-continental flight from Mineola, Long Island, to San Francisco, in two jumps.

The big Martin bomber commanded by Lieut.-Col. Hartz left Washington on July 25th, and safely made Mineola on the first lap, followed by another jump to Augusta, Maine. From Augusta, Maine, the big machine winged its way to Cleveland, Ohio, and so on in a series of flights which will take it along the borders and coast line of the country. There are four men in the crew, with Lieut.-Col. Hartz in command.

As for the flight under Captain Francis, the object is to prove the practicability of long-distance mail service in all kinds of weather. Captain Francis reached Mineola on the 25th, after a speedy flight from Dayton, Ohio. Accompanied by Lieut. E. A. Clune, the big bombing plane will make North Platte, Neb., in the first flight, or a distance of 1,509 miles from Mineola. The second leg will be to San Francisco, or a distance of 1,315 miles. However, at the time of writing we learn that a violent electric storm and gale has wrecked the Martin machine, so that flight must be postponed for some time, at least.

If Captain Francis makes his flight as planned, it will be the first long overland trip in which the airmen will depend upon navigating instruments rather than landmarks for guidance. It will be the first trip in which the aviators will attempt to maintain a set schedule. It is estimated that the journey will be finished in 40 hours after leaving the ground near New York, and the actual flying time will be about 32 hours.

The Martin bomber, which is being employed in each flight, is of the bomber type adopted by the Army some time before the signing of the armistice. It has a wing spread of 71 feet and is powered with two 400-horsepower Liberty motors. In official Army tests, this type has made 118 miles an hour carrying full military load. This included 1,500 pounds of bombs, besides the crew of four and the machine gun equipment.

The trans-continental machine has been changed only by the enlargement of the fuel tanks and the rearrangement of the fuselage which this necessitated. In the nose of the machine is the cockpit for the navigator. Directly behind him are seats for two pilots, arranged side by side. Dual control is provided, so that the pilots can relieve each other without moving from their seats.

Directly behind the pilots and in the center of lift of the machine are the gasoline tanks, of 640 gallons capacity. Behind the tanks is another cockpit for the mechanician. This cockpit contains much of the electrical equipment and controls and also provides toilet facilities and a space large enough for one member of the crew to recline. This rear cockpit can be reached by members of the crew forward by a rubber-treaded walk and a handrail leading over the top of the gasoline tank.

Capt. Roy N. Francis has been chosen as commander of the craft because of his long experience with Martin planes. He has made the unique record of flying one of the bombers, of the same type, 25,000 miles without a mishap and with only one forced landing because of engine trouble.

The navigating instruments carried on the trip deserve special attention, because chief reliance for success has been placed in them. Besides the usual air compass, the ship is equipped with a large Navy compass. Observations of positions are to be computed every hour by the navigator. For this purpose he will use a new "bubble sextant," designed to overcome the difficulty of finding the horizon, which aviators so often experience. It has been found that a "haze horizon" is usually visible from a great height and that it is often impossible to distinguish this from the true horizon. Thus observations made with the ordinary mariner's sextant, with which the position of the sun is determined by sighting on the horizon, is useless in the air. In the new sextant, a bubble, operating on the principle of the spirit level, provides a means of pointing the sextant in a level position, that is, at the horizon.

It usually takes the mariner of the sea about a half hour after he has made his observations to work out his position by a complicated system of logarithms. In a fast-moving airplane, however, this method is obviously much too slow, and it has been overcome by a circular slide rule with which it is possible to work out the position within two minutes. The navigator will have strapped across his knees a glass-faced box, under which the map of the complete route is placed on rollers. The map is transferred from one roll to the other as the flight progresses. In the bottom of this box is the circular slide rule.

The two pilots in the Martin bomber are surrounded by a bewildering array of switches, valves, levers, and instruments. The instrument board alone carries 16 instruments and all of these are vital to the well-being of the ship on the long flight. There are more than a score of controls lining the side of the cockpit and scattered about the pilot's feet.

The machine will be equipped for night flying. It carries red and green lights on the wing tips and a white light at the tail. Two flares are carried at each wing tip and these may be set off electrically from the pilots' seats when desired.

The crew will be equipped with a set of intercommunicating telephones, but no wireless will be carried. For reporting the progress of the flight, the machine will carry 50 small parachutes and telegrams, addressed to the Division of Military Aeronautics, and carrying a request that the finders forward them. The parachutes will be dropped at intervals.

Obviously, all this depends on whether or not Captain Francis is provided with a new machine, or whether the smashed bomber can be repaired. Meanwhile, the flight must perforce be held up because of the wiles of one of the strongest gales ever experienced in the vicinity of New York.

Commonwealth Drydock at Boston—Largest of Its Type

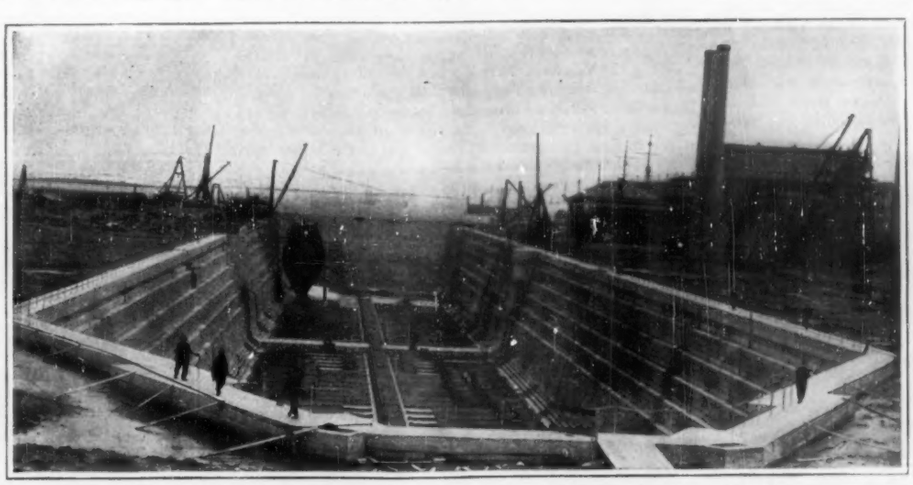
THE new Commonwealth Drydock at South Boston is the largest drydock of its type in the world. There may be floating drydocks which are larger, but there are no land drydocks of greater size. It is situated off the main ship channel in South Boston, and is ideally located, both as to the harbor entrance and to the New Haven Railroad yards. The Navy Department has agreed to buy this drydock, when it is completed, from the State on a cost plus basis. At the present time it is 95 per cent completed.

The particulars as to dimensions are as follows: Length at bottom, 1,170 feet; width at bottom, 114 feet, 9 inches. Depth over sill at low water, 35 feet. The size of the largest vessel which it could accommodate is 1,150 feet in length; beam, 115 feet; draft, 45 feet, high water. It is built of concrete side walls with complete granite facings. It has a floating steel caisson and is brought into place by electric winches. The length of the caisson is 138 feet, 6 inches; width, 27 feet; depth, 53 feet, 6 inches.

It has been approximately under construction for the last three years, but during the war building was considerably curtailed by the shortage of material and labor. It is understood that the Navy plans to make the drydock the biggest ship repair plant on the Atlantic coast and the repair plant is to be built alongside of the dock.

It is also understood that the Navy plans to build docks adjacent to this dock for berthing ships. The channel leading to the drydock from the main ship channel has a mean depth of 37 feet, and the State, before turning the dock over to the Navy Department, will dredge a turning basin outside. The time required to flood the dock is one hour. The time required to empty it is approximately three hours. The dock has a capacity of approximately 50,000,000 gallons of water. The emptying machinery is five centrifugal pumps operated by electricity. The dock is emptied and filled through a series of conduits having outlets in the floor

(Continued on page 147)

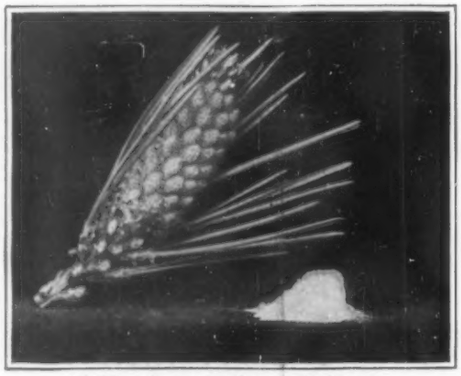


Bottom length 1170 ft., bottom width 114 ft., 9 inches. Depth over sill at low water 35 ft.

The new Commonwealth Drydock at Boston

The Pollen of the Pine

THE conifers rely upon the wind for the transport of their pollen from the staminate to the female flowers. The breezes are an uncertain agent for work of this kind and yet a very effective distribution is secured. This is due to the fact that the pollen is produced on an enormous scale. Whereas in many self-pollinating flowers the number of pollen grains is to be counted by thousands, in the case of the anemophilous blooms the production rises up into millions. A staminate inflorescence of any of the common pines should be gathered whilst the flowers are yet enclosed in the scaly cases. After a few days the blossoms mature, and the pollen may then be shaken out. An astonishing amount of pollen is thus obtained as can be seen by a glance at the photograph. The number of grains may be realized when it is remembered that, individually, they are hardly visible to the naked eye. A curious feature of the pollen grains of many of the pines is that they are provided with a pair of little wing-like projections. Without a doubt these devices aid the grain in aerial journeys.



All this pollen came from a single cone

New Discoveries Concerning the Manner in Which Roots Absorb Water

IT has long been the accepted view of botanists that roots are capable of absorbing liquids only in their middle portion which is often covered with root hairs, sometimes called "absorbing" hairs and that they cannot take up liquids either through the tips or through the denuded base. This view has been recently controverted by the distinguished French scientist, M. Henri Coupin, who has laid the results of his experiments before the French Academy of Sciences in two communications, the last of which has just appeared.

M. Coupin found that contrary to the received opinion the root is capable of absorbing water by its point, and he defines the latter as consisting, at most, of the root-cap (when it exists) and the terminal meristema which has been hitherto thought to lack entirely all absorbing power. He finds secondly that the water thus imbibed by the root is sufficient to permit the maximum development of germination compatible with the small quantity of nutritive elements furnished the plantlet in his experiments and with its life in the dark.

M. Coupin experimented with a variety of plants, all of which gave exactly the same results. He gives detailed accounts, into which it is not here necessary to enter, of his experiments with peas, beans, pumpkins and castor oil plants. He sums up his observations as follows: "As can be clearly seen in the four examples which I have just cited and to which I might add many others, the plantlet in which only the point of the root is in the water develops normally and the tap-root increases greatly in size throwing out rootlets copiously; furthermore, the aerial portion (the stalk or the hypocotyl, as the case may be) acquires a degree of development similar to that it would have had if the root had been entirely immersed in the liquid milieu. *A priori* one might be tempted to believe that this increase is due to the fact that the plantlet may borrow water either from the moisture of the air which surrounds it or from that contained in its own cotyledons or its own albumen. However, the behavior of the other specimen, which was placed exclusively in humid air and was identical with the first in respect to its hydratation, proves that this is not the case, since the latter specimen either remained almost exactly in its original condition or, at any rate, manifested a much inferior vitality."

In a second series of experiments, M. Coupin undertook to determine the comparative absorption of the root point and of the other portions of the root. For this purpose he compared the behavior of two identical roots belonging to the same species, one of which (A) had only its point immersed in water, while the other (B) was entirely immersed, *i. e.*, both its point and its piliferous region were immersed. The so-called piliferous region is the portion of the root covered with "root-hairs"; these are sometimes called "absorbent" hairs because of their supposed function, a function which M. Coupin denies to them. The experiments were all made at the constant temperature of 23° C. and were carried on in the dark and in a very humid atmosphere. If the atmosphere were not humid the roots would very rapidly dry up and die. M. Coupin considers this a most important detail, thinking it probable that former experimenters who made their investigations in the open air were thus led into error—since the roots under observation perished when only the point was in the water they concluded that the point could not absorb water. M. Coupin thus states the results of his observations: "All of these experiments agree absolutely in demonstrating the fact that *the root which is entirely immersed in the water does not grow any faster than that whose tip alone is immersed.* Furthermore the former nearly always exhibits a lesser degree of development than the latter, which at first glance seems paradoxical but is apparently to be explained by the the well-known fact that water in general retards growth. Moreover, it is observable that water often alters the root hairs, causing some of them to burst as can be seen under the microscope and thus producing an actual lesion of the radicular surface. The general impression made by these experiments was to the effect, indeed, that the root absorbs water exclusively by its point and not at all through the remainder of its extent. This impression becomes almost a certitude if one places a root in water in such a manner that only the piliferous region and not the point is immersed. This experiment is very difficult to perform and practically impossible to attempt with 99 per cent of seedlings, because of the root being too short, too difficult to curve or being covered almost at its birth with young rootlets. By making use, however, of certain seedlings of peas or Indian corn it is possible, because of the length of their roots to bend them in such a manner that the piliferous region is immersed in the water while the terminal portion extends into the humid air. Under these conditions it was clearly to be seen that the root *grows either very slightly or not at all* (one millimeter in 24 hours, for example); at most it may be observed that the point exhibits a slight inflection in the attempt to once more become vertical towards the bottom. At the end of a day or two, however, the plantlet seems to gain slightly in vigor, which is manifested by a *very slight* elongation of the root and of the other vegetative parts. But upon closer examination we perceive that this faint recrudescence exactly coincides with the appearance of short rootlets which have their birth between the root hairs. Hence we see that the plantlet really increases in size because of the absorption of water by the points of new rootlets and not by means of the root hairs. This is evidently the reason which has induced plant physiologists to believe that the piliferous zone was exclusively the absorbent portion of the root. My final conviction, therefore, is that *the root absorbs water exclusively by its tip and never by the root hairs.* The functions of the latter, which by the way in most cases scarcely develop at all except in the *humid air*, are apparently two in number: (1) To protect the root against too rapid evaporation which would be fatal for both it and the plant; (2) To attach themselves to particles of earth and to give indirectly a point of support to the tip of the root so as to enable it to penetrate as deeply as possible into the earth.

Cloud of pollen from a pine tree, and a few spores greatly magnified

Wilted flowers like these may be put in alcohol and hot water

Longleaf Pines Benefit by Fire

OBSERVATIONS by E. F. Andrews, reported in the *Botanical Gazette*, indicate that, within certain limits, small forest fires may aid the forester by promoting the growth of pines. Of two neighboring plots of ground on Lavender Mountain, Georgia, separated by a ravine, both densely overgrown with weeds, one contained five longleaf pines and the other four. The former was burned over, and soon after the fire it was found that 34 young longleaf pines, previously invisible on account of the weeds, were now in undisputed possession of the tract. The leaves, though scorched and burned off, had sufficiently protected the growing tip to preserve the life of the trees. Two years later there were 66 of these trees on the tract that had been burned and only two on the other. Rough experiments showed that the leaves of this species are not at all inflammable and are so arranged as to shield the growing point. To all appearances, exposures as long as eight minutes to a brisk fire of chips did not cause the death of seedlings a few years old. Mr. Andrews concludes that "when forest fires, especially of the minor type known as 'ground fires' and 'brush fires,' occur at not too frequent intervals, the immunity of the pines enables them to take the lead in the work of reforestation, and through the gradual elimination of their rivals to become finally the sole possessors of the soil."

Reviving Wilted Blossoms

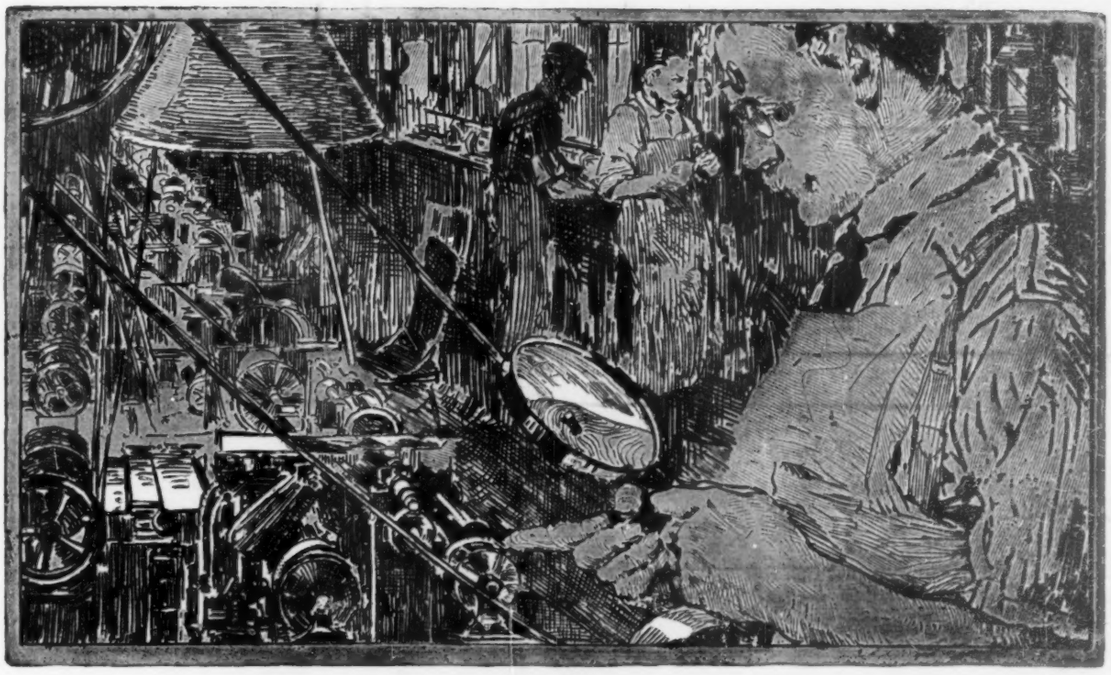
MANY lovers of wild flowers have doubtless been annoyed by the apparent impossibility of getting certain beautiful species home in good condition. Among the flowers of the eastern States which wilt almost while one is plucking them, the dainty little spring beauty and the gorgeous but bashful cardinal flower come to mind.

If one but knows how, one may freely gather these and others like them, and take them home in the thoroughly disreputable condition which they at once effect, with calm certainty of being able to restore them to their natural beauty. It is merely necessary to conquer the inevitable instinct to place them in cold water, and instead use the fluid piping hot, with more or less alcohol added, according to condition of the flowers and experience with the various species.

As evidence that this method of restoration applies equally well to cultivated blossoms, we illustrate the effects of a half-hour immersion in alcohol and hot water upon some wilted lilies.

Half an hour later they will show a most startling improvement

WALTHAM THE SCIENTIFICALLY BUILT WATCH



AND THE FOREIGN BUILT WATCH

The Smallest Screw in the World

Know These Facts Before You Buy a Watch

THERE are turning operations upon metal made by Waltham machinery that are so minute, so wondrous in their delicacy, so exacting in precision, that the mind is amazed at these triumphs of American skill in watchmaking.

Imagine a machine turning out by the many thousands, screws so small that the naked human eye sees them as points of metal shining under reflected light — screws that measure 254 threads to the inch, and you can put 47,000 of them in a small thimble!

Screws that are hardened and tempered, each one polished on the top — screws that are perfect in sphericity, perfect in thread, perfect for their place in the mechanism of that ladies' Waltham watch movement, which, when completed, is actually smaller in diameter than a dime — a ten cent piece!

The screws in the foreign made watch are made by hand. But comparing them under the magnifying glass we see the difference between these hand-made screws and the Waltham machine-made product. The foreign screw varies — the Waltham screw is standardized in size and perfection of workmanship.

No human hand could ever match the quantity and quality performance of machinery that creates such miracles as these.

This is one more of the many reasons why the world's leading horologists came to Waltham for time, and still another reason why your selection should emphatically be a Waltham.

This story is continued in a beautiful booklet in which you will find a liberal watch education. Sent free upon request

Waltham 7½ Ligne

The movement is actually smaller than a dime in diameter

$150 to $1,000 or more depending upon the case

WALTHAM

THE WORLD'S WATCH OVER TIME

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

A Governor for the Automobile and Tractor Engine

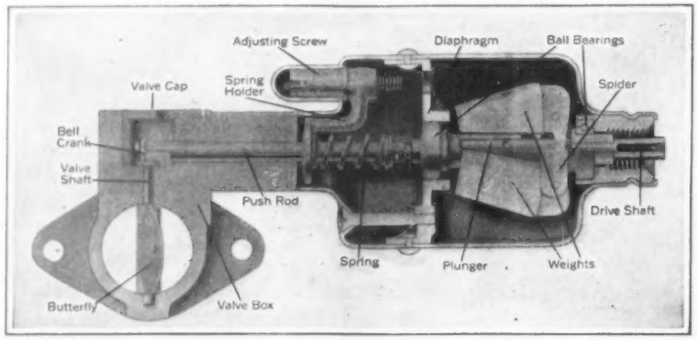
PRACTICAL engineering demands that mechanical power, whatever its source or purpose, shall be constant and positive. No machine can develop its highest efficiency if it races at lightning speed when work is light and drags slowly and laboriously when a heavy load is encountered. Such service will in a comparatively short time wreck the most substantial machine or power plant. In short, ungoverned power destroys.

With internal combustion engines, such as used in the various types of automotive vehicles, or even for stationary work, the governor proposition, because it is more difficult to solve, is frequently neglected altogether. This neglect is disastrous. In fact, the world's largest manufacturer of internal combustion engines states frankly that a reliable speed-controlling device will increase the life and efficiency of any motor at least 400 per cent. So it becomes quite evident that a governor is worth considering in connection with any form of internal combustion engine not so equipped.

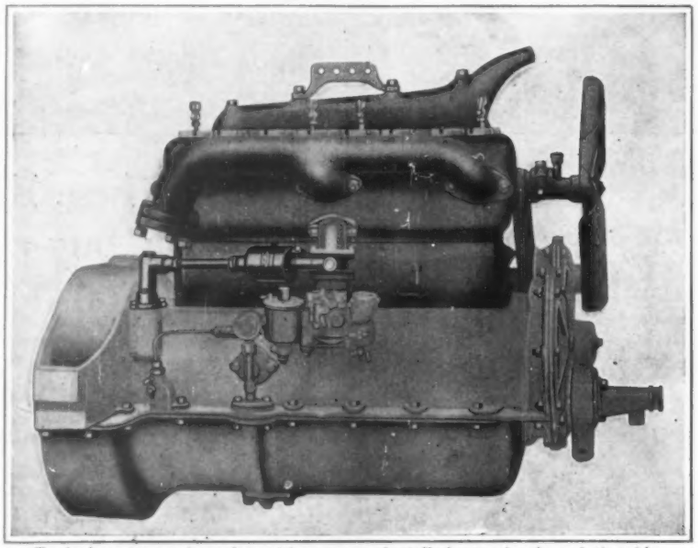
It has remained for an American inventor to develop a governor which employs the well-known principle of centrifugal force and which is entirely self-contained and enclosed in a housing small enough for any commercial purpose. While every part must be accurate in construction and assembly, yet the operation of this governor is exceedingly simple. The only rotating part of the governor is the weight spider, and as this runs on ball bearings in an oil bath, it requires no attention.

The governor proper is mounted between the carbureter and the intake manifold, and may be connected to the driving agent by means of either a solid or a flexible shaft. In the governor valve box the butterfly valve is normally in a position that does not obstruct the flow of gas, but it is closed so as to reduce the valve port area, just as soon as the motor reaches the predetermined speed. The valve is actuated by what is known as the flyball principle. The two weights are mounted on a spider, which revolves on ball bearings, and are so pivoted that as their velocity increases they are swung outwardly, forcing a plunger forward, which in turn operates the butterfly valve. The plunger is forced against a spring calibrated to a standard pressure, so that as the velocity of the weights is lessened they return to normal position and the valve opens.

Naturally, the governor requires some oil, but this is easily supplied through the oil cup in the governor case. The two weights splash the oil to all moving parts. The action of the governor is both positive and simple. The adjustment is easily made, and as the housing is dust and watertight, there is no probability of wear, if kept properly lubricated.



Sectional view of a successful type of automobile engine governor which operates on the centrifugal principle



Typical motor truck engine with governor installed, showing its relationship to other parts

Interlocking Self-Bonding Brick

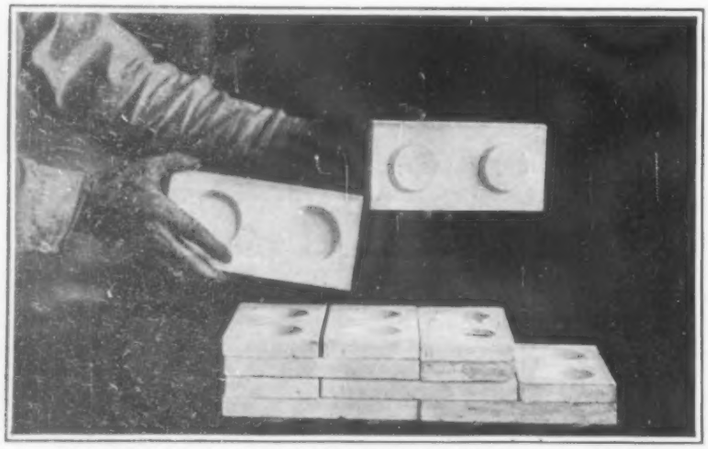
A CONTRACTOR of Yuma, Ariz., has brought out an idea which came to him as he watched gigantic skyscrapers of steel and brick crumbling back to earth in the San Francisco earthquake. His self-bonding and interlocking brick is now much in vogue in the Pacific states and is regarded by many brick manufacturers as something which is certain to revolutionize the material end of the building business.

The idea that Charles H. Brisbin got out of the San Francisco disaster was that a brick wall should not crumble and fall down. He believed that the world needed a brick which could be tied into the wall so it couldn't be removed without taking away all of the bricks over or under it. He worked out this idea in the form of a die which produced a brick having two annular depressions on one side and two annular bosses on the opposite side, the bosses being concentrically located with the depressions. This makes a perfect interlocking system possible. The bosses register into the depressions with absolute exactness, and the bricks bind themselves in whatever direction or form they are laid.

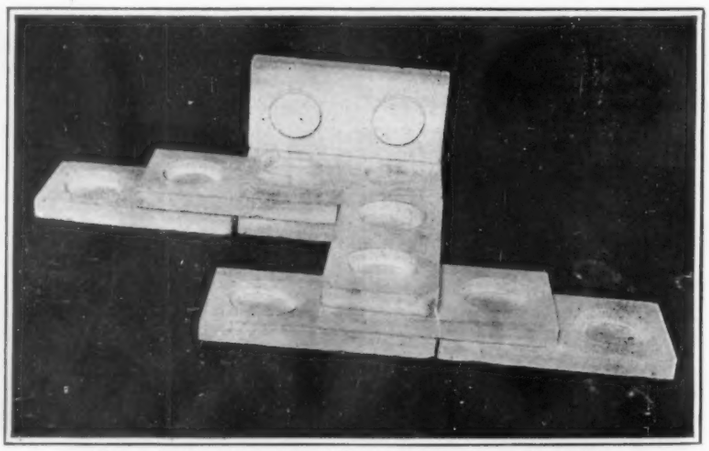
The construction of hollow walls is very popular just now, and brick men say that the Brisbin type of brick is particularly good for this sort of building, because it enables the builder to anchor one wall to the other. After being locked into one wall the bricks can be extended across the hollow space and tied into the other wall by the registration of boss in depression, and when a wall has been constructed in this manner it is there to stay—at least it cannot be toppled to earth by any seismic disturbance of ordinary violence. The hollow wall makes a building much cooler than is the case where straight brick wall formation is followed. Brisbin brick makes hollow wall building possible, without the use of steel cables, nails or wires.

These bricks are also said to be particularly good for the construction of chimneys. The old-fashioned kind of brick permits a chimney to expand from the heat, and costly fires not infrequently result from the pulling apart of chimney bricks at the corners or the development of crevices because of bulging. By using self-bonding brick a builder can lock all sides and corners of a chimney together so that it can't bulge or crack at any point.

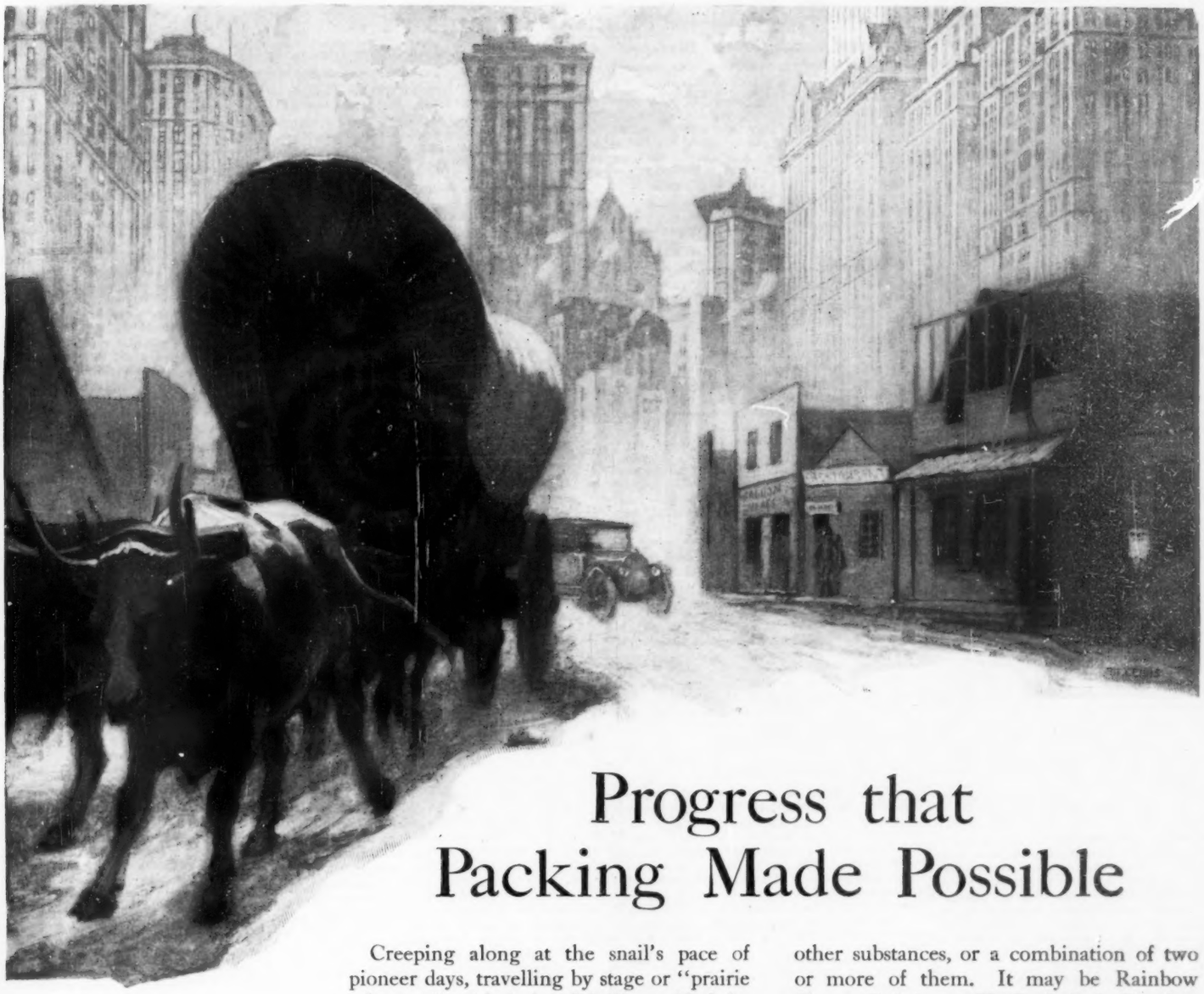
Scores of brick manufacturers in the Southwest, who have already begun making the brick, say it is the best material they have ever been able to secure. They are able to adapt their brick machines to Mr. Brisbin's dies in less than half an hour and at slight installation cost. The dies turn out the brick smooth side down so there is no difficulty in removing it from the machine.



Bricks with bosses and sockets that interlock making a self-bonded wall



How a double wall may be tied together by self-bonding bricks



Progress that Packing Made Possible

Creeping along at the snail's pace of pioneer days, travelling by stage or "prairie schooner" with industrial life typified by the village smith — that is a condition we would still endure were it not for packing.

Packing has made modern city life possible. It has built up giant industries, supplied high speed transportation, and furnished gas, electricity, running water and sanitation to homes and business buildings.

Packing has done this by preventing the leakage of steam, air, liquids and gases, and by supplying lubrication to pistons, plungers and other moving parts of engines and machines.

For each purpose there is a special type of United States Packing. It may be rubber, duck, flax, hemp, asbestos, metal or other substances, or a combination of two or more of them. It may be Rainbow Sheet, Rainbesto H. P. Spiral, Peerless Piston, Success Diagonal or any of the many other brands that complete the United States line.

And each type, properly applied, will prevent waste of power or material, minimize shut-downs and increase plant efficiency.

How well United States Packing stands up in service is being demonstrated daily in thousands of important power plants throughout the world.

Our packing engineers are ready to aid you in determining the most suitable type or combination to meet each of your needs.

United States Rubber Company

UNITED STATES RUBBER COMPANY
US
RUBBER SYSTEM
AND ASSOCIATED COMPANIES

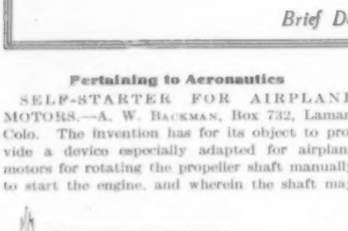
"The Right Packing in the Right Place"

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

SELF-STARTER FOR AIRPLANE MOTORS.—A. W. BACKMAN, Box 732, Lamar, Colo. The invention has for its object to provide a device especially adapted for airplane motors for rotating the propeller shaft manually to start the engine, and wherein the shaft may



SIDE VIEW SHOWING STARTER IN PLACE

be rotated from the seat. The mechanism comprises a shaft which is journaled in a suitable bearing frame rigid with the motor casing at one end the frame having roller bearing for engagement by the shaft.

SPEED MEASURING INSTRUMENT.—N. B. HALL, 411 Fifth Avenue, New York, N. Y. The invention relates to instruments, more especially for use in measuring the speed of airplanes. An object is to provide a device by means of which the speed of an airplane may be determined with fair accuracy by an observer in the airplane, from data which he makes during the flight. A further object is to provide a device which is simple in construction, and, therefor not liable to get out of order.

NAVIGATION INSTRUMENT.—C. L. POOR, 35 Thomas St., New York, N. Y. This invention relates to aerial navigation, its object is to provide an instrument more especially designed for use on airplanes, to enable the aviator to quickly determine the position of the airplane while in flight and without resorting to the use of logarithmic tables or requiring any logarithmic and other calculations. The device may also be used for marine navigation.

Electrical Devices

SPARK PLUG.—J. W. DRUMMOND, Chillicothe, Ohio. The invention relates generally to spark plugs and more particularly to an antifouling plug, the structure of which is simple and efficient, the object being the provision of a plug which will develop an extremely hot burning spark and will throw off grease and other carbon producing matter in action. The carbon being burned as it collects upon the electrode thus obviating fouling of the plug.

Of Interest to Farmers

MACHINE FOR THRESHING OR SHELLING GRAIN.—C. L. ST. CLAIR, Box 84, Concordia, Kans. This invention relates generally to the threshing apparatus and more particularly to a machine for threshing or shelling grain, the prime object being the provision of means by which hemp, Kafir corn, feddertor and other similar grains may be sheiled without injuring the hemp stalk or fiber, or in case of other grains, without heading, opening bundles or injuring the fodder.

HAND TRIP FOR GRAIN BINDERS.—Y. S. ELLINGSWORTH, Geneseo, Ill. The invention relates more particularly to binders of the type wherein an automatic tripping device is used. The object is to provide a hand tripping device operable independent of the automatic tripping mechanism, and a device which may be used in heavy grain or where the grain is down and clogs the machine. The device is very easily handled and responds to very slight efforts on the part of the driver, about one and one-half pounds of pressure is all that is necessary to trip the tier.

Of General Interest

SPRINKLER HEAD.—H. B. LONG, 515 Insurance Exc. Bldg., Chicago, Ill. The invention relates generally to sprinkler heads and more particularly to fire extinguishing apparatus, the object being the provision of a sprinkler head whereby to avoid all danger of its failure in acting. The invention especially relates to the connections or struts utilized between the clamping means and the pipe closing cap, its object being the provision of an arrangement whereby two struts may be effectively utilized with each sprinkler head for release of the pipe closing cap upon the fusible solder of either strut melting.

WAVE MOTOR.—A. ROOS, 1432 W. Monroe St., Chicago, Ill. The invention has for its object to provide a device especially adapted for utilizing the energy of moving water. In operation the incoming waves strike within the open end of pipes and the air and water mixed are driven upwardly with considerable force, both are trapped in a reservoir. Here the water will drive the turbine, and increased power is obtained by the compressed air. A safety valve prevents injury to any of the parts.

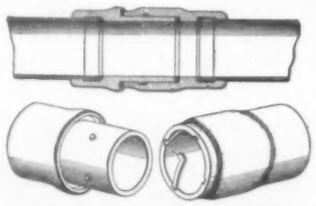
DROSS MOLD.—I. N. MINGER, 227 W. Lima St., Findlay, Ohio. The invention relates more particularly to a device for receiving hot dross as it is skimmed from the top of molten linotype and stereotype metal, in order to prevent the dross from running together into a hard mass, the object being to provide a device which will keep the dross in condition so that when emptied out, it will crumble into small pieces ready to be returned either to the metal pot or run through a dross sifter without further pounding or crushing.

SANITARY SHIELD.—J. W. TAYLOR, 1218 Allengrove St., Philadelphia, Pa. This invention relates more particularly to a sanitary toilet seat shield of that nature including a section of flexible material, preferably paper, which may form part of a roll, which is provided with perforated lines, the object being the provision of a shield the weakened portions of which are so arranged relatively to one another that the central portion of the shield may be broken away in a single movement to form the necessary opening.

SPOT WELDING.—W. R. THOMSON, Lancaster, S. C. The invention has for its object to provide a method of splicing steel bale strapping and the like to permit reuse of the pieces of strapping by converting the small pieces into a continuous piece of proper length and tensile strength. To accomplish this result the ends are lapped upon each other or are abutted and lapped upon another of the same material, and the ends and the pieces are spot welded in such manner that practically the whole width of the strapping is connected.

TICKET SELLER'S BOOTH.—A. FELLHEIMER, 7 E. 42d St., New York, N. Y. The object of this invention is to provide a construction for use especially in railway stations whereby each ticket seller may keep his stock of tickets independent of other ticket sellers A further object is to provide a booth with parts arranged so that a large variety of tickets will be within reach of the seller's hands without moving from his position in front of the window. The device may be removed from the window when not in use.

HOSE COUPLING.—T. P. SALLEY, 188 Clarkson St., Brooklyn, N. Y. This invention has for its principal object the provision of mating male and female pipe sections which are slidably fitted together and adapted for relative rotation,



A VERTICAL LONGITUDINAL SECTION, AND PERSPECTIVE VIEWS OF MALE AND FEMALE SECTIONS

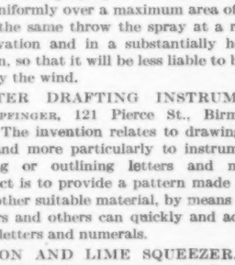
each of the sections having an annular rabbeted portion receiving an elastic gasket so that the end of one section is adapted to come wholly in contact with the gasket of the next adjacent section, so as to cause both sections to be drawn together to establish compressing contact of the sections with the gaskets when the sections are rotated in one direction and operatively brought together.

BAG HOLDER FOR COFFEE STRAINERS.—A. D. BARKER, Box 859, Yakima, Wash. The object of the invention is to provide a device by means of which a coffee holding bag may be supported within an ordinary pot, leaving the hands of the operator free for the coffee making, in order to permit the making of drip coffee with an ordinary coffee pot. The device comprises two rings hinged together, the upper overlapping the lower, both rings having handles which register.

SPRAYING NOZZLE.—B. G. PATTERSON, 339 Washington Ave. Fayetteville, Ark. This invention relates to a spraying nozzle having a rotary spreader for attachment to the end of a stand pipe or hose and is especially applicable for use as a lawn sprinkler. An object of the invention is to provide a spraying device that will distribute water uniformly over a maximum area of ground, and at the same throw the spray at a relatively low elevation and in a substantially horizontal direction, so that it will be less liable to be driven about by the wind.

LETTER DRAFTING INSTRUMENT.—W. HEPFINGER, 121 Pierce St., Birmingham, Mich. The invention relates to drawing instruments and more particularly to instruments for designing or outlining letters and numerals. An object is to provide a pattern made of metal or any other suitable material, by means of which amateurs and others can quickly and accurately lay out letters and numerals.

LEMON AND LIME SQUEEZER.—J. R. BOLTON, J. D. WILLIAMS and F. L. STRUVE, Sulphur Springs, Texas. The object of the invention is to provide a device by means of which a lemon, lime or the like may be halved,



A PERSPECTIVE VIEW OF THE SQUEEZER OPEN

and the halves squeezed in succession, or one half may be left unsqueezed. The device comprises a pair of plates hinged together, one of the plates having a recess, the other carrying a blade, and squeezing protuberances, one of the protuberances being movable with respect to the other to permit half the lemon to be squeezed.

LIFE-PRESERVER.—C. M. PRIMM, 232 E. 21st St., Long Beach, Cal. This invention has for its object to provide a device by means of which one in the water may propel himself while supported at the surface of the water. The device may be used by those learning to swim or for poor swimmers or for life savers, since it may be handled more quickly and expeditiously than a boat. The device is shaped like a small surf boat, the front is slightly upturned to facilitate its movement through the water.

CARRYING AND DRAG BAG.—A. W. SMITH, Richmond Terrace, New Brighton, S. I., N. Y. The invention relates to bags made of strong canvas, duck or similar material. The object is to provide a carrying bag more especially designed for conveniently carrying coal on board of a marine vessel, or from a wagon in the street to a coal bin. Another object is to render the bag exceedingly strong, by the addition of reinforcing ropes around the top, bottom, and at the sides, to permit of dragging the filled bag without danger of injuring it.

Machines and Mechanical Devices

SAWING MACHINE.—C. A. MOORE, Kinney, Minn. The invention has for its object to provide a device by means of which a cross-cut saw may be efficiently handled by a single man, to fell a tree or to cut the tree into suitable lengths after it has been felled, the operator working at one end of the saw. A tripod frame is provided consisting of sectional legs and a connection between the legs at one end, an arm pivoted to the frame with means for engaging one end of the saw, the other end having a handle, means for operating the arm to move the saw.

RABBLE AND CLINKER-BREAKER.—W. BOCKING, Rifle, Colo. This invention relates to a rabble and clinker breaker particularly suitable for zinc furnaces. An object is to provide an apparatus which is simple in construction and by means of which the grate of the furnace can be maintained clean of clinkers and in consequence, a more even feed of the charge of ore through the furnace obtained.

PRESSURE REGULATOR.—J. P. METZG, care The Leslie Co., Lyndhurst, N. J. The invention relates to fluid pressure regulators in which a diaphragm controls the action of the main valve, the diaphragm being pressed on at one side by a spring device and at the other by fluid pressure so that the high pressure fluid passing through the regulator is discharged from the latter to a predetermined lower pressure. This regulator is generally used in apparatus requiring an accurate functioning under constant pressure, and after being set to the predetermined pressure it can be locked.

ENGINE LATHE ATTACHMENT.—G. E. ROBINSON, 462 Hawthorne Ave., Portland, Ore. The object of this invention is to provide an attachment especially adapted for grinding, regrinding and boring engine cylinders, and which may be adjusted to grind cylinders of different diameters. The attachment comprises a shaft which has secured to one end thereof a grinding wheel; the shaft is journaled within a casing or sleeve. This sleeve at the end remote from the grinding wheel has threaded engagement with a hub on an offset plate which is adjustably connected with a base plate.

Railways and Their Accessories

LOCKING MEANS FOR FREIGHT CAR DOORS.—J. W. SMITH, P. O. Box 637, Ardmore, Okla. The invention has particular reference to locking means involving a series of locking elements disposed about the door at opposite sides and at the top and bottom thereof and controlled by the unitary operating means. The general object is to provide a lock for freight car doors, improved with respect to the form and arrangement of the locking elements and the actuating means.

Pertaining to Recreation

SWING.—J. B. DUNLAP, 618 N. Boston St., Tulsa, Okla. The object of this invention is to provide a device wherein the swing is operated by gravity, a fixed screw being provided, with which cooperates a nut carrying the seats or cars for the passengers, the nut and the cars or seats being rotated about the axis of the screw by the downward movement of the nut under the weight of the swing and its occupants.

Pertaining to Vehicles

TRANSMISSION.—A. E. STENBERG, Reed City, Mich. The object of the invention is to provide a simple and efficient transmission especially adapted for motor vehicles. The device is arranged within a housing of suitable construction, and the engine or driving shaft has its end received within the hub of a pinion or gear wheel, the said hub being journaled in a bearing in the end of the housing, ball bearing being interposed between the bearing and the hub.

DEMOUNTABLE RIM.—J. N. FOSTER, El Paso, Texas. The invention relates to demountable rims for vehicle wheels, it has for its object to provide a rim which may be locked to the rim or unlocked therefrom with a single operation. Means are provided for locking the rim from lateral movement, and means for controlling the locking, the means comprising levers pivoted to the felly and having cam heads for engagong the demountable rim the moving means for the levers comprising a cam ring mounted to rotate on the whell.

NON-SKID ATTACHMENT FOR WHEELS.—J. GAJAN, care Louis Krivacs, 27 Brookside Ave., Mt. Vernon, N. Y. Among the objects of the invention is to provide a non-skid attachment comprising an annular series of arc shaped plate sections adapted to be arranged in pairs on opposite sides of the tire or rim and having a plurality of spur members adjustably connected to each pair of plate sections the entire structure being applicable to or removable from a wheel with but little trouble, and being adapted to withstand the intense strains to which such devices are commonly subjected.

The Aberdeen Chronograph

(*Continued from page 141*)

line of sight so that velocity determinations can be made on any temporary range. Several instruments installed in a permanent instrument house, as at Aberdeen Proving Ground, naturally give more accurate records than a single chronograph, but the velocity as read with one instrument should be accurate within 34/100 of one per cent, which in the case of a velocity of 1,750 feet per second, such as might be obtained with an ordinary field gun, would correspond to 5.95 foot-seconds.

It is easy to replace the screens on the stakes so that 60 to 80 velocities an hour can be measured with the new instrument. It is also used to measure the velocity of shell fragments on burst, and also the velocity of propagation of a detonation wave.

To calibrate the chronograph a ballistic instrument known as the "Fall" is employed. This consists of a vertical standard with an electric release permitting a ball to drop a standard distance, the adjustment being made for one-fifth of a second. When the chronograph is tested against the "Fall" there should be five revolutions of its drum during the interval and the second spark should be directly under the first one on the strip.

It is obvious from this outline description that the Aberdeen Chronograph is very simple in its theory and mechanical design, and that its operation must depend largely upon the motor governor, a centrifugal device situated on the lower end of the motor shaft and rotating with the motor armature. A weight acting against a coiled spring moves with any variation in speed cutting in or out resistance in the motor circuit and thus maintains the normal speed constant within a margin of 1/5 of one per cent. The induction coil, condensers, and other elements of the instrument both mechanical and electrical, while specially designed and adapted, do not possess any striking novelty either in principle or application.

The Aberdeen Chronograph is one of a number of precise instruments which modern gunnery requires and which have been developed or improved during the recent war. The workers at the proving grounds who, using such instruments, develop and standardize service ordnance, and determine reference tables and other data for the gunners at the front, are in no small measure responsible for the good work of the artillery in battle and for its share in the winning of the war.

Economic Tree Murder

(*Continued from page 132*)

for our own needs and for a healthy foreign trade."

The answer to the problem is not difficult to make or to apply. If every man owning timber were considered as a custodian, not an owner of, a part of the nation's wealth, he would not be allowed to waste it. No man drives an automobile on a public road but pays a tax, secures a license and subscribes to and obeys the laws of traffic. No power boat plows any of our waters which is not under federal supervision. Our railroads must obey certain laws, for the good of the whole people. We are now in the throes of getting a workable water-power law. Our mines and out other natural resources are more or less conserved by law for the good of the greatest number. But our timber (save for our national forest reserves), our greatest, natural resources and our only renewable natural resource outside of water power, is allowed to be handled by private owners with no other thought than that of immediate private gain.

If all our forests were adequately protected against fire, if all our forests were so supervised and directed that they could not be cut faster than they grew; if all our forests were *harvested* instead of *destroyed;* if our cut timber was replaced, that nature might grow the stand which the ax and the saw reap; we would not have the present day condition of growing only *a third of what we cut* and having that growth of poorer grade, of inferior species and therefore inferior value to what it replaces.

If we started tomorrow to conserve our lumber industry, we could have in 50 years, an annual production of 60,000,000,000 feet a year without hurting our capital—our forests. But if we do not start tomorrow—or very soon thereafter—we must either discourage our export trade because we cannot manage our resources or—destroy our wood industry altogether that Europe may be lumbered, and a few private purses filled.

The government moves as the people move it. The remedy is purely a legal, governmental one. It can be enacted in a week—if we get at it. But we will never do it, without a popular demand, and a popular demand can only come from education, from a popular understanding of the seriousness of the situation. It is one which should interest every manufacturer into whose product wood of any kind enters, and every consumer who buys or uses anything which is made of timber.

Since every one must be in one of these two classes, if not in both, and considering this article as addressing the general public, it can most forcibly be said that the remedy for the murder of our forest resources is "up to you."

The Failing Dollar

(*Continued from page 133*)

It may be objected that it lies with the person entering upon such contract to gage future developments, and allow for depreciation of the dollar. Such allowance is at best difficult to make, and uncertain, and, as Professor Fisher puts it, "It is sound policy to lessen in *advance* the risk element, so that *future* contracts may be made by all parties on the most certain basis possible."

Fear has been expressed in certain quarters, that Professor Fisher's scheme, if adopted, would dislocate the present adjustment in the relative amounts of gold absorbed by the arts (jewelry, etc.), and in circulating currency.

This solicitude appears to be unfounded, as is shown by the following considerations:

The equilibrium between the amount of gold in the arts and in circulating currency is determined by the relation:

$$\left.\begin{array}{l}\text{Marginal utility of one}\\ \text{ounce of gold in the arts}\end{array}\right\} = \left.\begin{array}{l}\text{Marginal utility of one}\\ \text{ounce of gold currency}\end{array}\right\} = \text{Marginal utility for goods purchased for one ounce of gold currency.}$$

It will be observed that this relation does not in any way involve the monetary unit or its gold equivalent; the relation is, therefore independent of this unit, and cannot be affected by a change in that unit. In other words, whether I buy merchandise for five dollars of 0.05 ounces of gold each or for 5.10 dollars of 0.049 ounces each, and make all my other transactions in the same proportions, can not affect the ratio.

$$\frac{\text{Total gold in use in the arts}}{\text{Total gold currency in circulation}}$$

Professor Fisher's plan has received the endorsement of many eminent economists, bankers, lawyers and business men.

If we are convinced that the right remedy has been found, there still remains to be taken the third step, the adoption of the remedy. As stated at the beginning, this may prove the most difficult step in the reform, since it involves the overcoming of popular inertia.

The outlook, however, seems favorable, if we can judge by the progress already made. A number of public bodies have passed resolutions in favor of adoption or at least serious consideration of the plan. Among these are the Chambers of Commerce of Waterbury and of Bridgeport, Conn.; the New England Association of Purchasing Agents, and the Society of

Polish Engineers and Business Men in America. The New Zealand Board of Trade is also contemplating the establishment of a Commission to investigate the plan, and a similar movement was advocated by Delegate Tomaso of Argentina before the International Socialist Congress in Berne in February of this year.

Some Interesting Color Phenomena

(*Continued from page 135*)

viewed through such filters it appears red with a blue fringe, or vice versa.

After-images are well known and doubtless have been seen by most persons, but there are many interesting though obscure details which will not be touched upon here. To see after-images of colored objects in a striking manner a pattern is cut out of a brilliantly colored paper and laid upon a gray background as indicated in Fig. 6. In this case a green cross is used. The eye is fixated upon the green cross for ten or twenty seconds and the cross is snatched away without disturbing fixation. Now in the place of the green cross is seen a vivid purple pattern of the same outline. The best intensity of illumination varies with the color used. The gray should be of approximately the same brightness as the colored pattern in order to reduce the "brightness" after-image so that the "color" after-image is most conspicuous. In general, the after-image under these conditions is approximately complementary to the original stimulus. Many variations of this experiment are of interest. On replacing the gray by different colors, many brilliant effects are produced. On viewing various objects steadily and then suddenly closing the eyes or extinguishing the light, interesting facts will be noted. In general, these after-images are explained on the basis of retinal fatigue. For example (Fig. 6), the portion of the retina covered by the green image is fatigued to green so that when the green stimulus is replaced by the white-light stimulus (from the gray) the green component of the white sensation does not respond as fully as the remaining components (purple) with the result that the after-image is an unsaturated purple or pink—an excess of purple superposed on a white. These phenomena are visible on all sides and effective in many paintings. For example, the eye is seldom at rest, for even when attempting to fixate upon a point the eye is shifting with small and irregular movements. This causes an overlapping of after-images of colored areas with resulting "vibrating" or "lively" edges. This takes place on all parts of a painting, but is sometimes striking along the horizon of a landscape where the pinkish after-image from the green vegetation overlaps the gray or unsaturated blue of the horizon sky. In most of these cases successive contrast or retinal adaptation is important—that is, the effect upon a color of viewing another color immediately before.

After an intimate acquaintance with the science of color one concludes that simultaneous contrast is the overwhelmingly important factor in the appearance of colors. Without it colors barely survive. A red rose amid its green foliage is very red, but when seen against a red background it loses much of its "colorfulness." The effect of one color upon the apperance of its neighbors, the effect of its neighbors upon it, the effect of all colors upon each other, provide a maze too intricate to solve, but these reciprocal influences are the life of color. All about us are examples of the effect of simultaneous contrast. On a painting we may see a terra-cotta jardiniere containing a draping fern. In contrast with the green fern the jardiniere is quite vividly colored, but take a gray paper with a small hole in it and place this hole over the terra-cotta and its color greatly diminishes. In order to show this effect in a striking manner it is essential to get two adjacent colors as intimately in juxtaposition as possible. For this reason a star is an excellent pattern as shown in Fig. 7. There are many variations of this experiment. First, cut a star from a green paper and place a gray paper under this aperture. The gray star amid its green surroundings does not appear gray. It now appears an unsaturated purple—a pink. Under these conditions of a gray star surrounded by different colors, the color induced in the gray is approximately complementary to the surrounding color and usually is quite unsaturated. The next step in such a demonstration is to use two different colors for the star and its surroundings, respectively. From such experiments it will be concluded that, in general, complementary colors have the strongest mutual influence. One of the best ways to illustrate this phenomena is by the use of colored lights because the contrasting colors can be altered quickly by means of switches and rheostats. Anyone interested in color cannot find a more interesting and fruitful field of experiment. The author has been able to produce such powerful effects of simultaneous contrast that, for example, a grayish purple was changed in appearance to a grayish green by altering the color and brightness of the environment or surrounding color.

A variation of this experiment which also shows the effect of retinal adaptation is found in the photographic dark-room. When a red light is turned on in the presence of white light the former is very red, but after extinguishing the white light, one becomes less and less conscious of the redness of the red light until after an hour or so the red light appears quite unsaturated. If white light is leaking into the dark-room under the door or keyhole, this light appears very greenish. Under continued adaptation some colors almost disappear. This is especially true of blue-green, green and yellow lights of moderate saturation.

Intense colored lights or colors under intense illumination appear less saturated than when the intensities are moderate or low. For example, an artist acquainted with this fact will represent a deep red object under intense sunlight an unsaturated orange-red.

Binocular color-mixture affords interesting phenomena, some of which are still mysteries. If a red filter be placed before one eye and a blue one before the other (Fig. 8) a white paper viewed by both eyes does not appear purple (a mixture of red and blue), but appears alternately red and blue respectively. By steadily viewing the white paper it is sometimes possible to obtain a mixture. In general, however, the condition is a disturbed state of color. By viewing juxtaposed areas of different color with the eyes sufficiently out of focus to cause the images to overlap, the same retinal "strife" is obtained. The overlapping portion will appear red or blue with many variations.

The variation in the color-sensibility of different areas of the retina introduces peculiar phenomena in some cases. The central retinal region—the fovea—is less sensitive to violet, blue, and green rays than to yellow, orange, and red, due apparently to the yellow pigmentation of this region. It is difficult to describe a condition which effectively demonstrates this, but often as the eye roves over a medium shade of a color a spot in the central portion of the visual field appears of a different color than the remainder of the field.

It is a well known fact that at low intensities of illumination the color sensibility alters somewhat with the result that violet, blue, and green are favored at the expense of yellow, orange and red. For example, as darkness settles down on a landscape red flowers appear black, while green foliage and blue flowers retain their color longer and appear brighter than the red, if these colors are of approximately the same brightness at sunset. As the intensity decreases still further, all color disappears and we have merely brightness differences. It is readily observed that in dim moonlight no colors are seen in a landscape. These facts are of importance in certain color experiments.

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The foregoing and many other color phenomena are generally psycho-physiological in nature. There are many color illusions and near-illusions which appear to be purely psychological. In this class of color phenomena we encounter the inherent psychic powers of colors and their arrangements, but in many of them it is not difficult to trace the effects of association. These are too extensive to be discussed at this point, but they have been mentioned for the purpose of warning the reader to be on the lookout for them in any observation and use of colors.

The Heavens in August 1919

(Continued from page 138)

scopically as a crescent, growing thinner and thinner, though larger from point to point, day by day, and is worth watching.

Mars is a morning star in Gemini and Cancer, and rises at 4 A. M. in the middle of the month.

Jupiter is also a morning star, and is a few degrees east of Mars, that is, lower in the morning sky. The two planets draw closer together, to come into conjunction, less than a degree apart, on September 1st.

Saturn is in conjunction with the Sun on the 25th and is invisible. Uranus is in Aquarius, and comes into opposition on the 23d. At this time he is in 22h. 8m. 30s. R. A. and 12° 18′ 25″ south declination, and is moving 3s. west and 50″ north per day. There are no stars near by to serve as good sky-marks, so that a star-map will be necessary to find him.

Neptune is in conjunction with the Sun on the 2d, and is practically unobservable.

The Moon was in her first quarter at 4 P. M. on the 3d, is full at 2 P. M. on the 11th, in her last quarter at noon on the 18th, and new at the same hour on the 25th. She is nearest the Earth on the 4th, farthest away on the 18th, and nearest again on September 1st.

During the month she comes into conjunction with Uranus on the 12th, Mars, Jupiter and Neptune on the 23d, Mercury on the 24th, Saturn on the 25th, and Venus on the 27th.

Southport, Conn., 1919, July 21st.

Commonwealth Drydock at Boston—Largest of Its Type

(Continued from page 139)

of the dock. The five Worthington pumps, composed of three large and two small drainage pumps, have a capacity of 4,080 horse-power. Other facilities which the dock will have include enormous cranes, a modern ship repair plant including machine shops, carpenter shops, etc.

It will be noticed that an extra sill has been provided near the center of the dock. The inner dock will take a vessel 635 feet long; the outer dock one 490 feet long.

The drydock in addition to its ideal location with relation to the sea, is within a stone's throw of the new Army base at South Boston, the second largest Army base in the country; which has just been completed and cost approximately $28,000,000. The Army base is on a reserve channel in an inlet; so that steamers docking or leaving the new dock will not be interfered with by vessels going to or from the Army base. A quarter of a mile away is the new State Fish Pier and Commonwealth Pier, the largest passenger and freight pier in the world. All of these piers and docks are built on made land filled in by the State, and there are wonderful possibilities of further development. In fact, it is safe to say that there is no collection of docks and piers in the world which would more readily lend itself to expansion than these Commonwealth projects in South Boston.

Chemical Cleaning with Glycol

FOR chemical cleaning, benzine and tetrchloride of carbon are solvents for fat and are, therefore, preëminently suitable for removing grease spots and the like. In the case of spots and stains, however, due to coffee, cocoa or wine, good results have been obtained by using glycol which dissolves in water and boils at 198 degrees C.

Latest Patent Decisions

This suit involves an article for woven wire fabric used for screening ore. The screen is made of rolled, woven wire. Its meshes are oblong. The weft wires are larger, made of softer metal, and spaced farther apart, than the warp wires. By the rolling the warp wire is pressed into the weft wire, so that it is interlocked with it, and thus the wires are held in place and prevented from sliding upon each other. These screens are fitted into a frame which revolves rapidly. A pulverized metal by centrifugal force is thrown against the sides. Particles smaller than the meshes pass through, larger particles are returned to the rolls for further pulverizing. The desideratum was to produce a screen whose meshes would remain uniform during the life of the screen, would not clog, and would provide the largest amount of air space for the passage of the ore to be screened.

The principal competitor was a perforated slot screen. In this the weft and warp wires were of soft metal. The smaller wire wore out more quickly than the larger one, impairing the durability of the screen.

The patent calls for a screen in which the small warp wire is of harder metal than the weft wire.

The point is, did the substitution of a hard warp wire in place of a soft one constitute patentable invention. The court thinks it does not.—*W. S. Tyler Co. v. Ludlow Saylor Wire Co. U. S. C. C. A. of Mo.*

This is a motion for temporary injunction to prevent infringement of the Twitchell patent on the gage for testing the pressure in automobile tires. This is the gage well-known to the public. The nipple of the inner-tube valve is screwed off. The gage has a slip over coupling and anvil to cooperate with the inner valve stem and open the valve, so that the pressure operates to compress the gage spring and push out the cylinder beyond the top of the gage, on which the pressure may be read.

The motion for a temporary injunction should be granted. There is no question of the validity of the patent which has been several times adjudicated, and whose validity has been acquiesed in by the public almost universally. The sale of gages under the patent has been enormous, substantially as great as the sale of automobiles in this country. All the prior art set up by the defendant has been cited in the prior litigation on this patent. In that litigation 123 prior patents and eight prior publications have been referred to.

The Suiter English patent, upon which correspondence was had with the parties, was cited in prior litigation, and did not contain the slip-on feature, which is an essentially important element of the invention.

Injunction granted.—*A. Schroeder's Son v. Protex Mfg. Co. U. S. D. C. of Ill.*

The controversy herein lies in the commercial progress in the sale of containers and stands for solid alcohol. The patent features of the case are simple.

Plaintiff and defendant sell solidified alcohol in containers which are fitted into or engaged with a stand. These cans or containers are used by the public for cooking or heating purposes, and thus furnish a compact means for those who wish to avoid the employment of more expensive heating devices.

Prior to the time the plaintiff engaged in this business, solid alochol was well known as a fuel, as far bac'c as 1898. About 1902, one Rossman imported from abroad solid alcohol and a stove therefor, and attempted unsuccessfully to sell these articles.

In 1913 the Lava Heater Mfg. Co. placed upon the market a solid alcohol heater. Much money was spent for advertising, and a little later the business was taken over by the Ellenem Co. upon a royalty basis. This last company conducted an expensive publicity campaign. Shortly afterwards a device known as the (Home and Camp Cooker) was placed on the market. Soon after the plaintiff entered the field. He put out a single outfit, comprising a collapsible wire stand, a plain round can of solid alcohol, and a small tin boiler. This outfit sold for 50 cents. From this point plaintiff has developed its business to an extraordinary extent.

It is claimed that commercial thrift rather than invention should be credited with this growth. The fact that it was a new article comparatively and having plain or ungrooved containers negatives the idea that commercial success can be resorted to either in aid of the patent or of a broad interpretation of the claims.

Held, that where commercial success may be accounted for on other grounds, and the patent in suit plays either no part or an inferior part in attaining such success, a court must be cautious in giving it weight in aid of a patent, or a broad construction of its claims.

Held, that the patents in question, for a container, and for a combined lamp and stand, both relating to lamps for burning solid alcohol are void for lack of invention, and not infringed.—*S. Sternau & Co. v. Geor. Borgfeldt & Co. U. S. D. C. of N. Y.*

Fuller's Earth

AT Lancaster, Mass., occurs a deposit of fuller's earth which has been worked intermittently since 1856. While this earth possesses most of the properties common to other fuller's earths it has the additional characteristic of breaking down upon drying, and without crushing, to a closely uniform, fine product, free from grit, which will pass through a screen of about 250-mesh. While this property makes the material unfit for some uses, such as a filtering medium, it is peculiarly well adapted to certain other uses.

In the fulling of woolen cloth uniformity, fineness, and freedom from grit are essential, for grit or pebbles abrade and cut holes in the cloth as it passes over the rolls. Fuller's earth not only removes any grit remaining in the wool, but helps to flow the dye uniformly over hard-finished woolens. The earth from this deposit has been used in the woolen industry for over 60 years.

Another use has been developed in recent years dependent not upon its absorbent action, but upon its value as a binder when fused. Manufacturers of abrasive wheels and stones made both from natural and from artificial abrasives have used this earth as a binder.

The deposit lies nearly horizontal and is covered with a bed of gravel 2 to 2½ feet thick. The earth is stratified and varies in thickness from 2½ to 20 feet averaging about 15 feet. By small test pits reserves of 25 to 30 acres have been developed.

In mining the earth the stripping is first removed by wheelbarrows over a small area. Then the clay is cut down with picks and mattocks in benches about five feet high, loaded into wagons, and either hauled to the railroad siding or to a drying plant.

A very small area is stripped ahead of mining and low benches are used so as to minimize the danger of gravel slumping or being washed by rain into the good material.

Earth for abrasive manufacture is shipped in bulk, without drying; that for fulling must be dried and shipped in sacks or barrels. Drying is done under sheds or iron plates under which hot air from a coal or wood fire circulates. From wagons the earth is shovelled into sheds for storage, then shovelled onto the drying plate. After thorough drying the earth is shovelled into dry storage bins, where it is sacked or barrelled, and is then hauled by wagon to the railroad.

It is thought that much more extensive uses for this material might be developed by a thorough study of its chemical and physical properties.

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